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(GEOLOGICAL MAP.)

THE STRUCTURAL AND ECONOMIC GEOLOGY OF ERIE
COUNTY.

JAMES HALL,
State Geologist.

IRVING P. BISHOP,
Assistant.

1895.

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Geology

JAMES HALL, *State Geologist*,

SIR:—In this report are included the results of geologic studies in Erie county, N. Y., begun during the summer of 1895 and continued to the close of that year. The purpose of the investigation was to ascertain the boundaries of the formations for the geologic map of the state, and to collect data regarding economic products derived from rocks found within the county.

Respectfully yours,

IRVING P. BISHOP.

BUFFALO, N. Y., *January* 1, 1896.

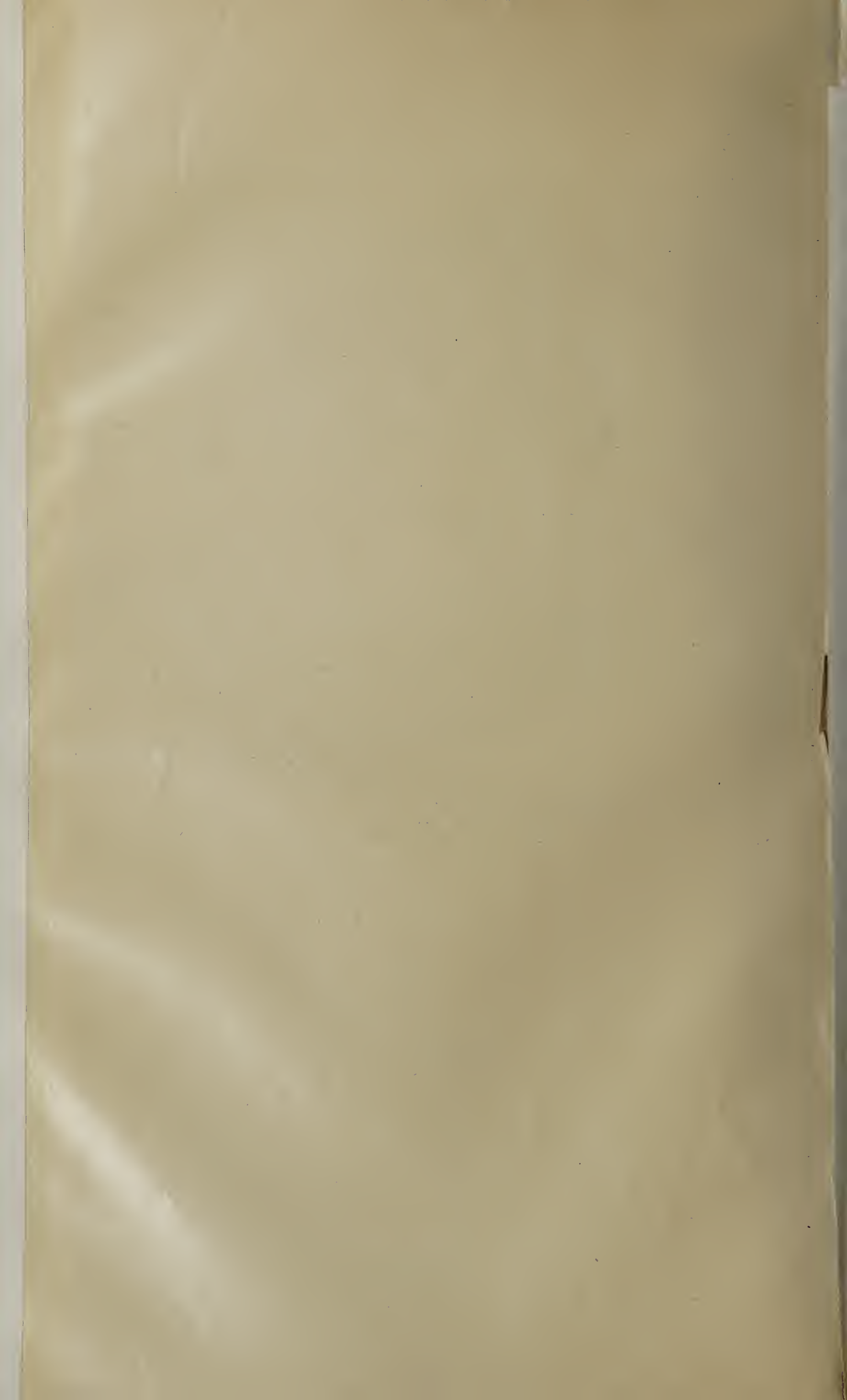
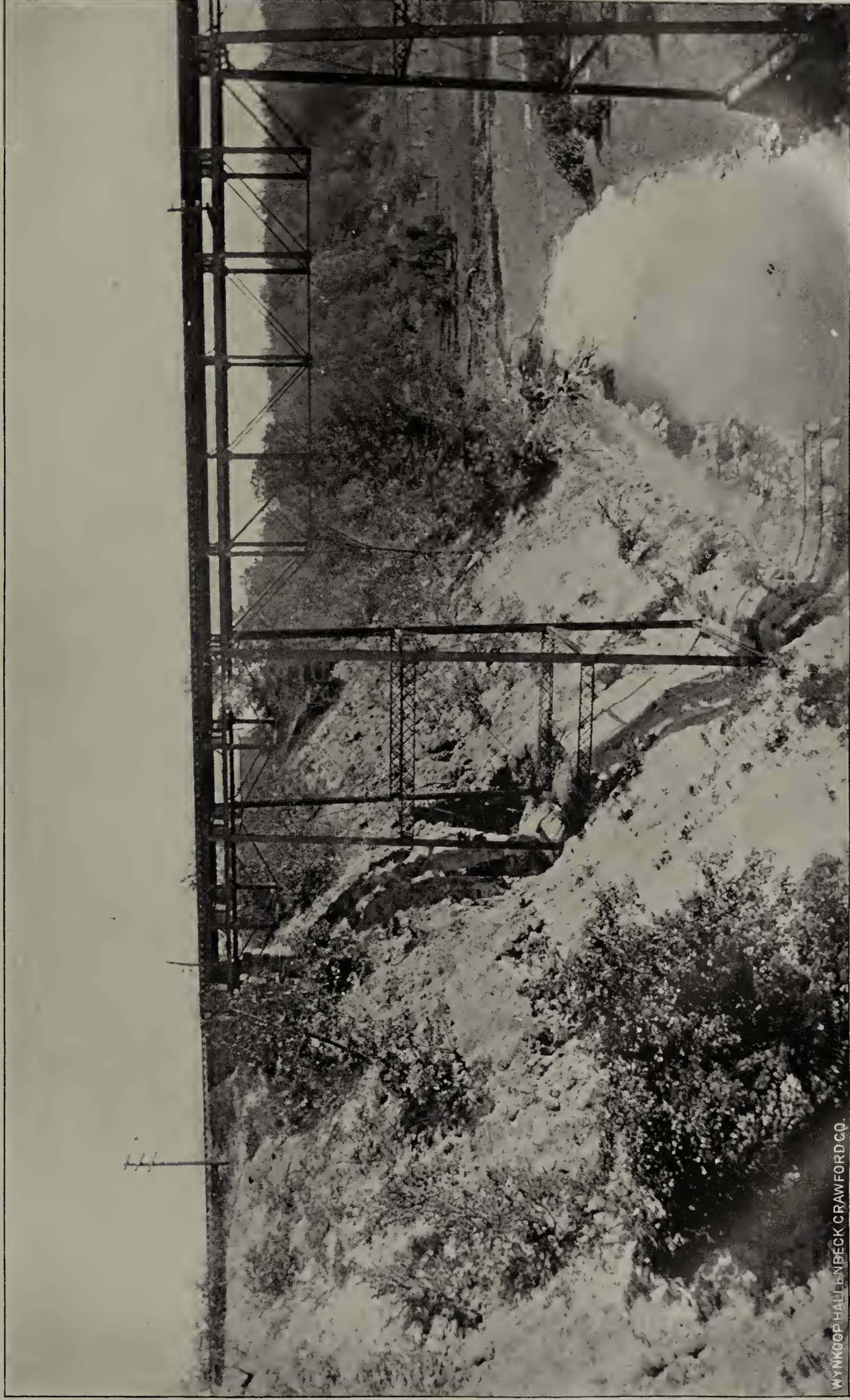


PLATE I



WYNKOOP HALL EN BECK CRAWFORD CO.

GENESEE AND PORTAGE ROCKS IN EIGHTEEN-MILE CREEK, AT NORTH EVANS. THE PIER IN THE MIDDLE FOREGROUND RESTS UPON THE TOP OF THE GENESEE; THE NEXT PIER TO THE LEFT RESTS ON THE TOP OF CASHAQUA SHALES.

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The Structural and Economic Geology of Erie County.

BY IRVING P. BISHOP.

PHYSIOGRAPHY.

Erie county, in central-western New York, is bounded on the north by Niagara county, on the east by Genesee and Wyoming counties, and on the south by Cattaraugus and Chautauqua counties. The western limit is the international boundary from the lower end of Grand Island, to a point where the boundary line makes a right angle with a line drawn to the mouth of Cattaraugus creek. It is separated from Niagara county by Tonawanda creek and the west branch of Niagara river; and from Cattaraugus and Chautauqua counties by Cattaraugus creek.

The extreme length of the county, north and south, is forty-three and one-half miles, and its greatest width is about thirty-nine miles. The land surface contains 1,071, and the lake portion about 160 square miles, giving it a total area of about 1,230 square miles.

Topographically, the county comprises three provinces. They are—*first*, a low and nearly level plain on the north, extending from the Niagara river and Tonawanda creek to the limestone terrace; *second*, a slightly higher plain having the limestone escarpment for its northern boundary and extending southward to a line drawn through Bay View, Spring Brook and Marilla; and *third*, a region of rolling hills rising gradually to the height of 1,500 feet or more above tide, and occupying almost all of the southern half of the county.

The Northern Plain. This plain includes nearly the whole of the townships of Grand Island, Tonawanda, Amherst and Clarence and the northern half of Newstead. Along the Niagara river the banks form clay escarpments averaging about twenty feet in height and dropping abruptly to the edge of the water. From the top of the bank the county extends southward in an almost level plain, unbroken by hills or ridges, to the foot of the limestone escarpment.

The Middle Plain. The middle plain rises abruptly from the northern plain, presenting throughout the greater part of the northern boundary an escarpment of limestone varying from twenty to one hundred feet in height. South of this, the surface is gently undulating with a few lower hills, generally presenting smooth surfaces. On this plain, Murder creek, Ransom creek

and Ellicott creek take their rise and flow northward across the lower plain to Tonawanda creek. The other streams which traverse the middle plain are Cayuga creek and its branches, Buffalo creek, Cazenovia creek and Smoke creek, the last three of which have their sources in the hill region to the south.

The Hill Region. The elevated region comprising the remainder of the county consists essentially of a high plateau gashed by streams which have eroded much of the original surface and left it a succession of valleys and ridges.

In the vicinity of Chaffee, East Concord and westward, this tableland has attained the height of nearly 1,500 feet A. T. From this there is an abrupt slope into the valley of the Cattaraugus creek, with a more gradual descent toward the north and west. From the Buffalo and Southwestern railway toward the lake, the descent is very gradual and the surface smooth or gently undulating, terminating at the lake shore in abrupt bluffs. Along the southern crest of the plateau and extending into the Cattaraugus valley are immense piles of glacial debris, giving rise to a peculiarly knolly topography. The principal streams flowing westward from this region are the Big Sisters creek and the two branches of Eighteen-Mile creek. In their upper courses these have steep-sided valleys, and in the lower courses deep gorges with precipitous walls of rock. The ridges between the streams have smooth tops on approximately the same level.

STRATIGRAPHY.

The rocks exposed in Erie county range from near the bottom of the Salina shales to near the top of the Portage group. The members in their order are shown in the following table:

Portage group.....	{ Upper.
	{ Lower.
Hamilton group.....	{ Genesee slates.
	{ Hamilton shales.
	{ Marcellus shales.
Upper Helderberg group...	{ Corniferous limestone.
	{ Onondaga limestone.
Water-lime group.	
Salina group.	

The thickness of the above rocks as ascertained by deep borings and measurements will be given at the close of the chapter on natural gas.

The Salina Group.

The rocks of this group are not well exposed in Erie county, the best section being found in Genesee county, east of Erie county, where the Tonawanda creek crosses the outcrop of Corniferous and upper Salina beds. The creek here breaks over the edge of the Corniferous limestone and hydraulic limestone, forming the Indian falls. Just below the fall, the rock is a thick-bedded limestone containing nodules of gypsum and weathering with a cavernous, irregular surface. Below that, the rock is shale, mostly gypseous in character, sometimes reddish, but more often grey or bluish. On the Indian reservation, near the mouth of the ravine, a limited amount of gypsum is quarried, blue-grey or mottled in color and of fair quality. About half a mile above the West Shore railroad bridge is an outcrop of red and grey gypseous shales which continue through the reservation to the iron bridge near the Indian church. Below this is a stratum composed of hard, thin-bedded calcareous rock, containing minute lenticular cavities and casts of crystals. The rock exposure extends about 200 yards below the bridge.

Within the limits of Erie county, the Salina rocks are mostly covered with drift. The most complete section is found in the bed of Murder creek at Akron. From Falkirk down to Main street are the water-lime rocks. Below the railroad bridge, shales crop out in the bed of the creek for two miles or more. The thickest exposure of these showed three feet of light-colored calcareous shale, weathering to light pink, beneath which were four to six feet of harder, greenish shale. A small exposure of shale is reported in the same creek opposite the end of the road leading east to the Indian reservation, but I was unable to visit it.

An outcrop of thin-bedded hydraulic limestone occurs on the farm of Martin Racquet, about one-half mile south of East Amherst near the Transit road, where it is used for macadam.

On Grand Island there are two outcrops. The more northerly is at Edgewater, about 200 yards below the boat-landing. The rock here is:

- (1) Black shale in the river-bed.
- (2) Greenish shales containing nodules of gypsum, one and one-half feet.
- (3) Light-colored, soft, friable gypseous shales, five feet.

The exposure extends 300 yards down the river-bank.

The other outcrop is at the extreme southern end of the island, where the river separates into two channels. The rock is a thin-bedded, impure limestone, weathering like the water-lime, and containing minute lenticular cavities. Fragments of such rock are plentiful in the drift about Buffalo,

and it is probable that this stratum is the source from which these fragments were derived.

On the Canadian side of the Niagara river, from a point about opposite Strawberry island to the International bridge, there is an almost continuous exposure of shales, nearly all of which are more or less gypseous and often spongy, as if mineral matter had been removed by solution. A short distance above the bridge, water-lime appears in the river-bed and can be traced to a point opposite to, or a little above, the stone church.

The Hydraulic Limestones.

The northern edge of the Corniferous limestone, together with the Onondaga limestone and the upper part of the hydraulic limestones, form a well-defined escarpment running in a general southwesterly direction from the Genesee county line to the city of Buffalo. For the greater part of that distance this escarpment is approximately parallel to the Bloomingdale and Williamsville roads, as is seen by the accompanying map. Within the city it follows the general direction of Main street from the almshouse to near the New York Central railroad belt line at Rodney and Fillmore avenues. After crossing Main street, it passes near the corner of Oakwood and Woodward to Oakwood and Parkside and enters the park at the stone quarry, crossing from there into the cemetery at the corner of the iron fence near Agassiz place. From here it sweeps around in a curve to Scajaquada creek at Main street bridge, and passes out of sight beneath the drift on the left bank, about 300 feet below the bridge. By examining sewer cuttings, holes for telegraph poles and other excavations, the edge of the Corniferous limestone is found to lie between Potomac and Bird avenues on Norwood avenue, and appears near the Niagara river at the corner of Auburn and Niagara streets, where there is a good outcrop. On the Canadian side of the river, the edge of this limestone should be near the ferry landing. The rock is well exposed a short distance above.

The hydraulic limestone is usually visible at the base, or north side, of this escarpment as a stratum of variable thickness in the face of the cliff, but occasionally forms a terrace ranging from a few feet to 200 yards in width, and approximately parallel to the escarpment. This terrace is most conspicuous between Williamsville and the Buffalo city line. In the Bennett-Pierce tract the hydraulic limestone is found near the surface as far north as the swamp, and I am informed by Mr. David F. Day, that it occurs near the surface at the deer paddock in the park. Sewer and other excavations have

thrown up this rock along Bird avenue, near Elmwood, and in several places near the Niagara river in the vicinity of Auburn and Bouck avenues. The rock is not eroded to its base so that a complete section is nowhere visible. The thickness has been ascertained from well sections given elsewhere in this report.

UPPER HELDERBERG GROUP.

Onondaga Limestone.

In Erie county, this formation appears as a thin band lying between the hydraulic limestones and the overlying Corniferous limestone. In color it ranges from blue-grey to a very light grey. It varies greatly in thickness, being from three to five inches at the Main street bridge over Scajaquada creek, Buffalo; seven feet in Forest lawn cemetery; five and one-half feet in the park quarry, and thirty-five feet in Fogelsonger's quarry at Williamsville. At Young's quarry, two miles further east, it is thirty to thirty-five feet thick, but thins out rapidly beyond to a thickness of three to five feet. Speaking broadly, we may say that the formation is concretionary in character, the deposits at Fogelsonger's and Young's being merely lenticular masses of unusual size. Small lenses a few feet in diameter are frequent and usually extend downward into the hydraulic limestone without any corresponding depression above, showing that they had their origin while the latter was yet in process of deposition. The larger nodules are remarkably rich in organic remains. At Fogelsonger's quarry the rock in many places is a solid mass of cyathophylloid and favositic corals, the latter frequently having their cavities filled with petroleum and bitumen. Single specimens were noticed four feet in diameter, and large areas of the quarry bottom showed little else than these fossils.

The Corniferous Limestone.

The northern edge of the outcrop of this formation is marked by the escarpment already described. A deposit of drift from ten to fifty feet thick covers the southern edge, so that actual contact with the Marcellus shales above is not found within the county. At Corfu, three miles east of the county line, the borings for gas passed through thirty feet of Marcellus shales. According to this, the Corniferous limestone should be found about a mile north of that village. The most southerly outcrop of this limestone near the county line is near an abandoned railroad track two miles northeast of Crittenden. A small exposure occurs on the edge of a marsh just northwest

of South Newstead. Half a mile below Mill Grove, near a dam across Ellicott creek, is a good exposure of the same rock, and other outcrops occur in the bed of the same stream for three miles below and, again, near Wilhelm. The limestone is found in Cayuga creek at Kieffer's quarry near the Transit road, about a mile west of Lancaster, and in numerous places below, the last exposure being at the end of Clinton street, where the creek unites with Buffalo creek. The deep wells at the Snow Steam Pump Works near Bailey avenue and Seneca street, at the Atlas Oil Refinery, and at the Buffalo Chemical Works on Buffalo creek and Abbott road, all started on the Corniferous limestone as bed-rock. It is found in the Ohio basin, near the lake, and was found by the engineers when sinking piles for the Lehigh docks and trestles, near Lake Erie.

The *Stafford limestone* of the Marcellus formation, is exposed at Wende station on the Lehigh railroad, one and one-half miles south of Mill Grove. As this stratum lies about twenty feet above the top of the Corniferous limestone, the boundary between the latter and the Marcellus shales must be at about half-way between Mill Grove and Wende. An outcrop supposed to be of this Stafford limestone occurs on the farm of Martin Martin, one-half mile east of Alden Center, and the drift in the bed of the most northerly branch of Ellicott creek, near Alden, contains abundant fragments of black shale as far east as the county line.

At Lancaster, the contact lies between the lower bridge and Kieffer's quarry. The Stafford limestone crops out in the bed of Buffalo creek, opposite the end of the Winchester road, and the Corniferous appears at the junction of the same stream with Cayuga creek, less than two miles away. Dr. H. U. Williams informs me that a limestone scored with glacial scratches was uncovered while grading the road-bed for the Buffalo, Rochester and Pittsburg railroad, some years ago, at the point where it diverges from the Western New York and Pennsylvania, and the Lake Shore railroads. Although I did not find the exposure during either of two visits made for the purpose, the excavations being filled with water, I have no doubt that the rock in question was the Stafford limestone. When the gas-well was sunk in South park, less than a mile and one-half southeast, the drill passed through "about thirty feet of shale below the drift, and then several feet of limestone and shale mixed;" conditions which confirm the view expressed.

At Stony point, on Lake Erie, fragments of the jet black shale of the lower beds of the Marcellus are numerous among the boulders which cover the beach, showing that they were derived from rocks farther north. The

boundary between the two formations must therefore lie between here and the Lehigh docks, and it is very probable that Stony Point itself marks the extension of the Stafford limestone into the lake. It may be assumed, therefore, that the boundary between the Corniferous limestone and Marcellus shales, as laid down on the accompanying map, is a very close approximation to the actual one.

HAMILTON GROUP.

Marcellus Shales and Limestone.

The best section within the county of the lower Marcellus beds occurs in the vicinity of Lancaster. In Cayuga creek, just above the lower bridge, is a layer about two feet thick, of a firm, jet black shale containing some iron pyrites in crystals and concretions. This is overlaid by a foot or more of grey limestone which had been mostly quarried out and could not be accurately measured. From the bridge up to near the Lake Como dam, the rock does not show. Just below the dam, the black shale crops out, capped by the Stafford limestone, which was at one time quarried here. A careful estimate, based upon the thickness of the rock in sight, the fall of the stream, and the measured height of a dam in the village, shows that the rock from the lowest visible stratum is from fifteen to twenty feet below the Stafford limestone. On a little brook running through the centre of the village, there is a fine exposure of the Stafford limestone. In sight, at the base of this, is a two-foot layer of jet black bituminous shale, smelling strongly of petroleum and containing pyritous concretions. Above this are the limestones in layers of the following thickness:

LOWEST—	12 inches, containing <i>Orthoceras</i> .
	6 “ “ “
	14 “
	10 “
	18 “
	14 “ with a little flint at the top.
	14 “
	12 “

Total, 9 ft. 4 in.

Above Lancaster, the shales are black, thin-bedded, friable and show very regular jointing. Farther up, the layers become more calcareous,

forming, at the mouth of Little Buffalo creek, a stratum of impure limestone. Shales of blue-grey color occupy the bed of the creek at intervals for three or four miles to the eastward.

Besides the outcrops of Stafford limestone already mentioned, there is a disused quarry of that stone in the field northeast of South Buffalo station on the Western New York and Pennsylvania railroad, and fragments of it were thrown up in digging the sewer and water trenches on the Indian church road, near Seneca street. The only places where the orthoceratite layers were noticed are at Lancaster and Wende. Other exposures of Marcellus rocks in the county are in the bed of Ellicott creek between Wende and Alden Center and above Alden Center near the Erie gravel pit; also in the southern branch of the same creek north of Alden village. In Buffalo creek it is in sight at intervals from the end of the Winchester road to within a mile of Blossom. It occurs on Cazenovia creek, at the Park just above the Cazenovia street bridge, and for some distance above the covered bridge two miles farther up the creek. It was also found in laying the water pipes for South Park, 700 feet east of South Park avenue, at the city line, within two feet of the surface, and in the bed of a small brook near by. At West Seneca, outcrops occur in the bed of Smoke creek, between the White's Corners road and the Western New York and Pennsylvania railroad, and again on the lake shore at Bay View. From here it forms the lake bottom near the shore for several miles up the lake.

Hamilton and Genesee Shales.

The transition from the Marcellus to the Hamilton shales is very gradual, the shale changing from black to blue-grey through almost imperceptible gradations. There is, however, in several places within the county, a stratum always calcareous and usually much harder than the rocks below, which seems to furnish a boundary between the formations.

A mile east of Alden, in the bed of the creek above the culvert is a layer of impure limestone three and one-half inches thick. Below this, the rock is a soft shale, having *Styliola fissurella* as its most conspicuous fossil, with an occasional cephalopod. The layer of limestone is not very fossiliferous, and has the appearance of some of the Marcellus rock. Less than six feet above is a shale containing excellent specimens of *Spirifer mucronatus* and *Athyris spiriferoides*. Just above this is a concretionary layer, less than a foot thick, containing characteristic Hamilton fossils, and immediately over the last a third calcareous layer, containing the usual Hamilton trilobites, orthoceratites and brachiopods.

PLATE II



WYNKOOP HALLENBECK CRAWFORD CO.

VIEW IN EIGHTEEN-MILE CREEK AT NORTH EVANS, ONE HUNDRED YARDS BELOW THE LOWER RAILROAD BRIDGE. THE STYLIOLA LAYER APPEARS IN THE BED OF THE CREEK ON THE LEFT. THE LONG PIER OF THE BRIDGE, SHOWN IN PLATE I, IS SEEN THROUGH THE ARCH.

A large fragment of limestone of several tons weight and containing numerous Hamilton fossils was noticed in Cayuga creek near Town Line. It evidently had its origin in that vicinity, although the parent rock was not found.

At Blossom is a four-foot layer of a limestone sufficiently durable for bridge work. It contains the fossils common to the horizon of the Encrinal limestone and Moscow shales, including an abundance of cyathophylloid corals. Examination proved that it lies just above a well-marked Marcellus outcrop. On the west branch of Smoke creek, a mile below Windom, a hard calcareous shale, eighteen inches thick, occurs in the same relative position as the preceding limestone. Another outcrop is seen where a little brook crosses the Mile Strip road about 200 yards east of the Hamburg turnpike. The rock here is a fairly good limestone. At Bay View the corresponding horizon is represented by a soft calcareous shale about two feet thick, capping the cliff a short distance south of the hotel.

While by no means certain of the continuity of this calcareous stratum throughout the county, in the absence of evidence to the contrary, I have provisionally assigned it to the horizon of the beds termed the "Basal limestones" by Professor J. M. Clarke, and have used it as a basis of measurement in determining the thickness of the Hamilton and Marcellus rocks.

At Eighteen Mile creek, near Lake Erie, the Moscow and Genesee shales have thinned out, leaving the Encrinal limestone near the top of the series.

The rocks here above the Encrinal limestone are:

Blue Moscow shale, resting on the Encrinal, . . .	15 ft. 4 in. .	} Hamilton.
A layer of iron pyrites $\frac{1}{4}$ to $\frac{1}{8}$ inch thick, sometimes merely a stain of rust, believed to represent the Tully limestone.		
Blue shale,	1 ft. 2 in.	
The "Styliola band," consisting here of		} Genesee.
(a). Hard Calcareous shale,	3 in.	
(b). Soft Shale,	2 in.	
(c). Iron grey limestone, containing fish-plates and crinoid stems,	4 in.	
(d). Firm iron grey limestone, composed largely of <i>Styliola fissurella</i> , . . 8 to 12 in.	1 ft. 9 in.	
Black shale, about	14 ft. 0 in.	

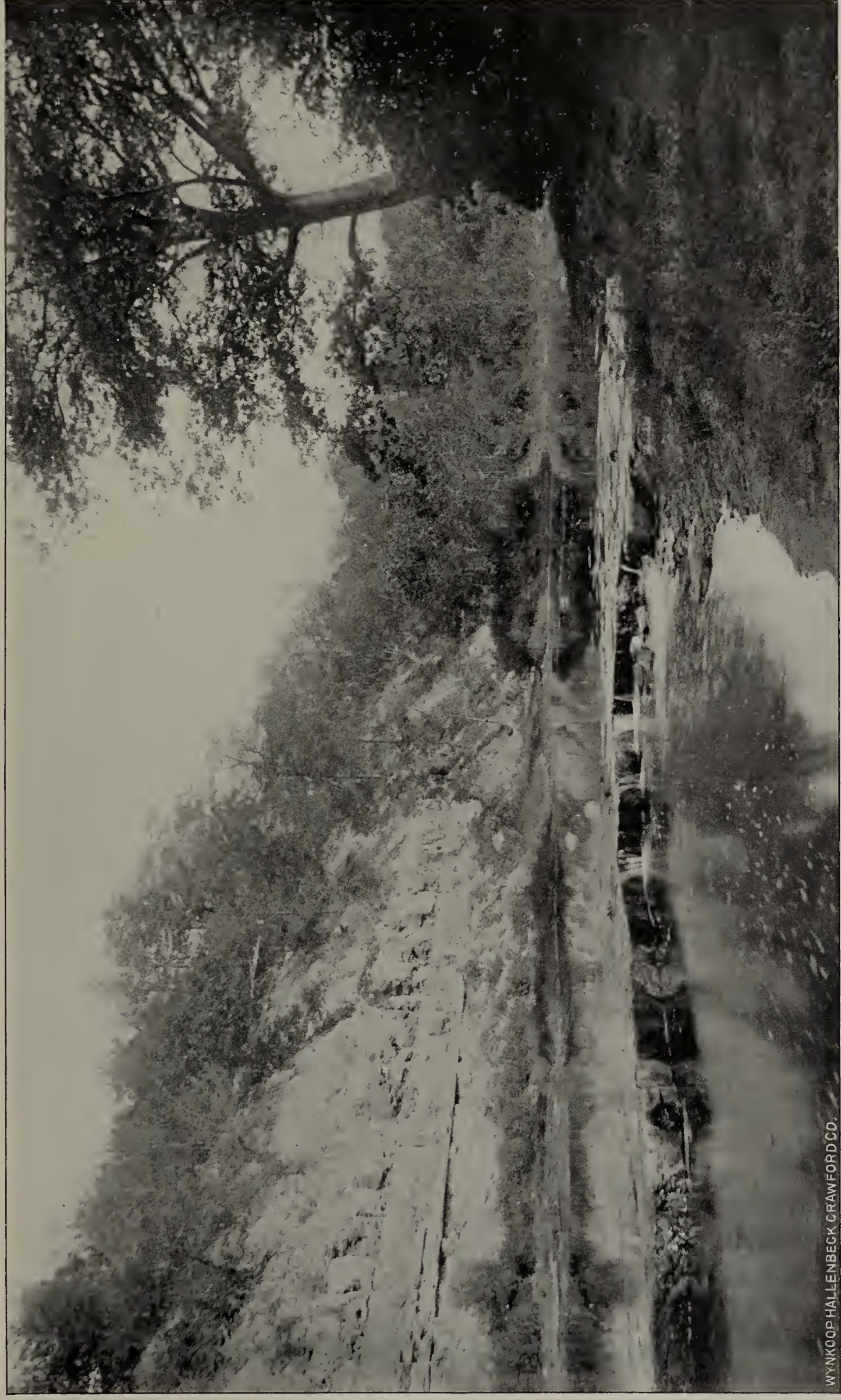
Then follow twenty feet or more of olive-green shales with numerous concretions, capped by black shale extending to the top of the gorge.

The thin layer beneath the "Styliola band" is blue and contains Hamilton fossils, but is more fissile than the shale below, which contain trilobites. Mr. A. W. Grabau, who has made a very careful study of this layer, says, it appears to have the fauna of both the Moscow and Genesee beds, and may be regarded as a passage formation from one to the other.

The relation of the Encrinal limestone to the Styliola band and associated rocks at Eighteen Mile creek is well shown in accompanying photograph.

Owing to its position near the upper part of the group and the ease with which it can be traced, I have selected the Encrinal limestone as the horizon of reference from which the top of the Hamilton and Genesee may readily be found. It is easily recognized as a hard limestone, two feet or more thick, usually stained on the under surface with iron rust from the decomposition of pyrites, and containing large crinoid stems, some of which are nearly an inch in diameter. Excepting a few outcrops of the "Basal limestone," there is no other rock in Erie county from the Stafford limestone up to the Portage sandstones sufficiently durable for bridge or building purposes. The shales immediately above and for several feet below are always rich in fossils, among which cyathophylloid corals and brachiopods, *Atrypa reticularis*, *A. aspera*, *Athyris spiriferoides*, *Spirifer medialis* and *S. mucronatus*, are particularly abundant. Since it resists the action of water and other erosive influences better than shales, it is found in almost every gully and ravine which cross the outcrop. Along the lake shore westward from Eighteen Mile creek, it forms a conspicuous band in the face of the cliff, dipping beneath the surface of the water near Pike creek. The Styliola band may be seen above it, the two limestones approaching each other slightly near the western limit. East of Eighteen Mile creek, the Encrinal limestone caps the bluff for a short distance, and is next seen by the road near the house of Mr. Crocker, about two miles further on, reappearing again in the face of the bluff beyond. From here it can be easily traced to Wanakah, crossing the creek near the station just below the railroad bridge. At Hamburg-on-the-lake it is a half-mile, and at Athol springs about 200 yards east of the railroad. At Big Tree, it is exposed in the railroad cutting near Rush creek, and on the banks of the stream by the farmhouse above. At Windom, it is found for some distance along the sides of the ravine, being well exposed just above the bridge near the station and crossing the bed of the brook a quarter of a mile further up. It is here about thirty inches thick, in two layers, the lower of which is the thicker, and has three or four inches of pyrites at the bottom. The Styliola

PLATE III



WYNKOOP HALLENBECK CRAWFORD CO.

THE ENCRINAL LIMESTONE IN EIGHTEEN-MILE CREEK; VIEW TAKEN FARTHER DOWN THE CREEK. THE STYLIOLA LAYER IS SEEN ABOVE ON THE LEFT OF THE PICTURE.

band crops out near the road to Duel's Corners, crossing the bed of a brook 200 yards above the bridge, about half a mile east of Hamburg station. It is here twelve to eighteen inches thick and lies six feet above the layer of pyrites representing the top of the Hamilton shales. The pyrites at this point and at other places eastward, is from two to four inches thick. I was unable to estimate the thickness of the Genesee, as it was partly hidden by drift.

The Encrinal limestone crops out in Smoke creek near the plank road, a mile north of Webster's Corners, at the top of a fall some thirty feet high. At Spring Brook it crosses Cazenovia creek just below the dam, appearing on both sides of the gorge for a mile below. The thickest portion measured was four feet from top to bottom, with one layer of eighteen to twenty inches.

The favosite corals here had their cells filled with crude petroleum and other bitumens so that a tablespoonful could be scraped with a knife from the surface of a single specimen.

The Styliola band is well shown for a mile above the dam, having about the same thickness as at Windom. It is here from four to six feet higher than the top of the Hamilton.

A small exposure of the Encrinal limestone is seen three-fourths of a mile east of Spring Brook station, where a small brook flows under the track of the Western New York and Pennsylvania railroad. It is next found where the covered bridge crosses Buffalo creek, two miles east of Elma.

The limestone crosses the creek just below the bridge, and is quarried along the bank and on top of the bluff farther down the creek.

The top of the Hamilton shales dips to the level of the creek, one-third of a mile above the bridge. The pyrites layer varies from one to four inches thick, and lies five feet below the Styliola band. The latter is six inches thick, representing only the upper part. When the concretionary lower layer appears, as it occasionally does, along the bank, the whole thickness is increased to a foot and the upper part also becomes concretionary.

The bed of Little Buffalo creek, below Marilla, is filled with drift so that no bed-rock appears. The Encrinal limestone crops out in the bed of a small brook emptying into Cayuga creek on the north side near the town line between Alden and Marilla. It again appears about a mile from Alden village, south from the station, where the road passes a wood-lot. The rock has been quarried in a small way near the top of the hill, and an excellent spring issues from beneath an outcrop in the woods on the other side, a few

rods from the road. Between here and the county line, I was unable to find any further exposure of this limestone.

Just south of the Erie railroad tracks, a mile east of Alden, is a good exposure of the Moscow shale with a fauna like that found near the Encrinal limestone at all points west; and in the absence of evidence to the contrary it is assumed that this limestone crosses the county line near the New York, Lake Erie and Western railroad. If so, the Hamilton must be thinner here than it is east or west of Alden. The Genesee slates in Erie county belong mainly to the part lying above the *Styliola* band, as already shown.

The Portage Group.

The Portage rocks crop out south of the foregoing, to the county line, no area of distinctly characterized Chemung strata having been observed by me within the county. The lower part consists of alternations of olive-green with bituminous black shales, including, rarely, a thin layer of argillaceous sandstone. Above these, the rocks become more arenaceous, passing somewhat abruptly into a series of shales alternating with argillaceous sandstones of varying thickness which furnish stone of considerable economic importance. The boundary between the upper and lower beds is therefore indistinct. North of a line connecting Wales Centre, East Aurora, North Boston and North Collins, no sandstone of consequence has been noticed, and none has been seen west of the Buffalo and Southwestern railroad, between the latter place and Gowanda. The streams flowing across the lower Portage outcrop have cut deep gorges with precipitous sides, but are almost destitute of waterfalls. The black shales contain many calcareous septaria, usually lenticular and of enormous size. Specimens six feet in diameter are comparatively common, and one measured nine feet in diameter by five feet in thickness.

The gorge of Eighteen Mile creek above North Evans, and of Cazenovia creek below East Aurora, show good lower Portage sections and furnish excellent specimens of septaria. The southern part of the county is covered with drift, which in some places is 500 feet or more in thickness. This has hidden the rock and broken the continuity of observations, so that complete sections of the Portage rocks like those made in Livingston and Wyoming counties have not been achieved. The valley of Buffalo creek, above Wales Centre, shows heavy sandstones and flags as far south as the town line between Wales and Holland.

Stone is quarried on the Joseph Myers farm, two miles east of Wales Centre, and also on the Ulrich farm on the Centre Line road, about one and

PLATE IV



RELATIONS OF THE ENCRINAL LIMESTONE AND STYLIOLA LAYER ON EIGHTEEN-MILE CREEK. VIEW TAKEN ABOUT ONE-FOURTH MILE FROM THE LAKE.

one-half miles southwest of Wales. The two branches of Cazenovia creek afford the best sections of the upper part of the Portage.

The argillaceous sandstone crops out along the road from Wales Centre to East Aurora, being quarried a mile east of the latter place on the farm of W. C. Cook. The layers are from eight to twelve inches thick with the characteristic surface markings. From East Aurora south, the heavy sandstones are found at intervals all the way to within a short distance of Holland. Two and one-half miles southeast of East Aurora, on the farm of Delavan Caulkins, a quarry is worked by Mr. Henry Strong. The rock here resembles the Warsaw bluestone and contains the vertical fucoids which are common in Portage strata. The principal layer is three feet, six inches thick. Mr. Strong also works another quarry on the north side of the valley, the stratum apparently corresponding to that in the Caulkins quarry. At South Wales is the best exposure of sandstone seen. It is located on the farm of Charles M. Brayton, about twenty rods east of the railroad water tank. The section here is:

Hard blue sandstone	2 feet.
Shale and thin sandstone mixed, about	20 “
Hard blue sandstone with vertical fucoids	6 “

With thin sandstones and shales above.

Following the railroad south, these sandstones dip below the track at intervals, the last disappearing at the twenty-fourth mile post from Buffalo, two miles north of Holland. From here to Protection, the rock observed is a black fissile shale stained with iron. East of Protection, there is an outcrop of sandstone with layers a foot thick. Between Chaffee and the county line, the rock is blue shale with thin sandstones, none of which were thick enough for flags. This rock has the appearance of Portage. I could not hear of any stone quarries in this vicinity, although one or two were reported near Arcade, in Wyoming county.

On the west branch of Cazenovia creek, sandstones occur in several places, but are generally thinner than those seen on the east branch. They occur on the higher ground near Jewettville, on both sides of the creek. On the Phelps farm, two miles southwest of East Aurora, there is also a quarry of flagstone eight inches thick, from which blocks ten feet square have been taken. The stratum is comparatively thin, but is near the surface and easy to work. Below Griffins Mills are several layers from six to eight inches, with one at least twelve inches thick. A quarry of this stone is worked on

the hillside, about half a mile farther east. Between here and West Falls there are no sandstones except a few thin flags among the shales. At the latter place there is a stratum about six feet thick, containing layers like those at Griffins Mills. From here to East Concord, all the rock in sight consists of shales and thin argillaceous flags.

A mile northwest of Springville, on the farm of Mr. F. A. Clark, is a quarry containing a six-foot layer of a grey siliceous sandstone, unlike any seen elsewhere in the county. In this stone I found several fossils, among which Professor J. M. Clarke recognized *Chonetes scitula*, *Productella speciosa*, *Orthothetes Chemungensis* (small variety), and a small *Spirifer* of the type of *S. mucronatus*. These, he says, are representatives of the Ithaca fauna, and not members of the normal Portage fauna. In the drift near by were fragments of a small branching coral which may have had its origin in this vicinity.

On the opposite side of the road, the same stratum of stone is worked in a quarry owned by Mrs. B. Wheeler. At Pike hill and Townsend hill, three miles southwest of Boston Corners, are quarries of heavy sandstone, which are described by Mr. Albert Pike, a former owner, as "grey sandstone," and may belong to the same horizon. Owing to the approach of winter I was not able to visit these quarries. In the vicinity of Boston and Boston Centre, the rock is mostly shale with no thick sandstones; but there is a quarry on the Zeller farm, four miles south of Boston Centre. At the viaduct over Cattaraugus creek, near Springville, the deep gorge of the river is cut through olive shales containing very little arenaceous matter.

From Shirley, near North Collins, to Collins, the argillaceous sandstones occur, being quarried on the farm of Daniel Sherman, two miles north-east of Collins. They appear to belong to the lower sandstones of the group. At Zoar, the Cattaraugus creek has cut a gorge through the Portage, exposing two strata of sandstone. The upper, near the top of the bank, is twenty to thirty feet thick and separated from a lower fifteen-foot stratum by about thirty feet of shale. Above Zoar, for five or six miles, the rock along the river is an olive shale with thin arenaceous layers, but no heavy sandstone. In the southern part of the county, a fucoid resembling the *Spirophyton caudigalli* is very abundant, fine specimens occurring in the gorge at Zoar.

A few poorly preserved brachiopods were noticed in loose micaceous rock in the bed of a stream near Lawton's. From the appearance of the fragment the stone had been washed down from the eastward and possibly may have been derived from adjacent Portage rocks.

PLATE V



WYNKOOP HALL ENBECK & RAWFORD CO.

PORTAGE SANDSTONES AT WEST FALLS,

Quaternary Geology.

Wherever limestones are freshly uncovered in this region, their surface is found to be polished by glacial action, the striae extending from northeast to southwest. Excellent illustrations may be seen at Fogelsonger's quarry at Williamsville, in the Forest Lawn cemetery at Buffalo and at the Lehigh coal shed near Cheektowaga. At the last named place several acres were stripped of drift to expose the rock, which was used as the floor of the structure. The surface was slightly undulating, well polished, with grooves rarely exceeding half an inch in depth. One set of striae was noticed crossing the others, but it was of limited extent and evidently of local origin. The accompanying photograph, taken at the southern end of the shed, gives a fair idea of the glaciation here.

Up to the base of the Hamilton group the bed-rock is covered with clays, varying from a few inches to sixty feet in depth. The lower stratum is a blue clay filled with smoothed and striated boulders. Above that is a red clay, seldom containing stones larger than a man's fist, and at the surface is a thin deposit of muck alluvium or stratified gravel.

A well on the farm of William P. Carr, near the lower end of Grand Island, shows the general succession of strata, as follows :

Loam	6 feet.
Red clay	20 "
Boulder clay	14 "

A copious flow of water was struck at forty feet. The top of the well is ten to twelve feet higher than the surface of the river, which is here twenty-two feet deep. Another well, a mile and a half farther south, passed through similar strata. At Sour Spring grove, on Grand Island, opposite Tonawanda, the drift is sixty feet deep and in Tonawanda village fifty feet deep, as shown by boring in both places. At Getzville, it ranges from twelve to sixty-nine feet, the latter depth being found near a creek. At Rapids, a water well forty feet deep did not reach bed-rock. Along Buffalo creek, within the city of Buffalo, the superficial deposit is about fifty feet thick. Although the areas outside the river and creek bottoms are more thinly covered, numerous borings and excavations show that the average thickness of the drift over the area under consideration is not far from twenty-five feet.

The surface of the Hamilton and Portage rocks is covered with drift somewhat unevenly distributed but increasing in depth toward the south. The upper rocks of the Portage group from Chaffee to Gowanda appear to

have been the dumping-ground upon which the great glacier deposited the most of its load. In the vicinity of Zoar, the borings for gas showed, in two wells, 325 and 379 feet of drift respectively, while the Kelly well passed through 515 feet, which is, within my knowledge, the deepest ascertained thickness of drift in the state. In connection with this it is interesting to notice that the greatest depth of drift in Wyoming county, 358 feet at Gainesville, is found near the top of the Portage group. Along the sides of the streams flowing through these deposits are many thick beds of clay which appear to be of finer quality than the great sheet which overspreads the lower levels. These clays are often laminated, when dry splitting like shale. Examples of these were noticed along the west branch of Cazenovia creek above West Falls and on a branch of Cattaraugus creek near Springville. There is also a good exposure back of the Lehigh coal shed at Cheektowaga.

Stratified sand and gravels occur in several places throughout the county, but in no order which would indicate a general system of deposition. An irregular strip lies about midway between the limestone terrace and Tonawanda creek nearly all the way from Getzville to Akron. Another extends from Orchard Park to Elma Center and for several miles west and east of these points. Large deposits were also noticed at Chaffee, Brant Center and other places in the southern part of the county. While these affect the character of the soil for agricultural purposes they are of small economic value. The deposits utilized by railroads for ballast are usually pockets of small extent and due to local causes. The Erie gravel pit at Alden will serve as a good type of this class.

Soil.

The northern plain has a soil consisting largely of clay loam which is somewhat heavy and holds water. Over large portions, however, and especially along Tonawanda creek, there are considerable areas of deep alluvial river-bottom which are extremely fertile and furnish good crops. The limestone ridge is well drained, has a larger proportion of gravel mixed with the clay and is better adapted to wheat and other cereals. The middle plain consists mainly of alluvial creek-bottom, well suited to market gardening to which it is chiefly devoted. Along the lake slope south of Buffalo the disintegrating shale forms, with glacial gravels, a soil well adapted to fruit raising, which is further favored by a mild, uniform climate due to the neighborhood of the lake. The tops of the hills southward are covered with stiff-clay which produces good grass and supports large dairying interests. In the

PLATE VI



GLACIATED ROCK SURFACE, LEHIGH COAL SHEDS, CHEEKTOWAGA.

WYNKOOP-HALL-LENBEG-CRAWFORD CO.

vicinity of Chaffee, Springville and along the slope of the Cattaraugus creek, the deposits of glacial drift combine many elements of fertility and form a rich and productive soil. As a whole, the agricultural interests of the county are varied and include the principal branches suited to the climate of this state.

Springs.

The hydraulic limestones at the foot of the Helderberg escarpment furnish copious springs, often smelling strongly of sulphuretted hydrogen. The largest within the county are located below the Fogelsonger quarry at Williamsville. Within a quarter of an acre, sufficient water rises to run a grist-mill. In searching for a source of water supply for Williamsville during the past year the flow of water from these springs was measured by the engineers and found to be one and one-half million gallons daily.

In the bed of Murder creek at Akron, just below the dam, there are several springs, one of which fills a five-inch pipe with cold, sweet water. Another, twelve feet away, is strongly charged with sulphuretted hydrogen. The gas-wells at Akron, Clarence and Williamsville have also tapped sulphur water.

Preglacial Erosion.

The Niagara river, as it leaves lake Erie, breaks across the lower part of the Corniferous limestone opposite Fort Porter. The river bank meets the lake shore bluff near the New York Central railroad bridge over the canal, forming an obtuse angle. About a hundred yards below this bridge, between the railroad and the canal, is a small quarry from which stone has been taken during the past season for canal repairs. The freshly stripped surface of the rock I found to be smoothed and striated by glacial action down to within two feet of the bottom of the quarry, or to about the level of the canal tow-path. Below that were evidences of glaciation but partly hidden by earth so as to render it doubtful whether or not the striae extended lower. From the top of the bank to the lowest well-defined striae is thirty-seven feet, eighteen feet of which is drift, leaving nineteen feet of glaciated limestone below the surface of the rock escarpment.

The layers next to the river were slightly terraced and the edges afterward smoothed, showing that the rock was removed before glaciation took place. The bed of the river opposite this place, as shown by the United States Survey, is twenty-one feet below the surface of the river or approxi-

mately thirty feet below the level of the canal tow-path. Across the river, the limestone in sight is water-worn but not glaciated. The highest outcrop, however, is not more than five feet above the mean surface of the river. It may be assumed, therefore, that the present channel of the Niagara river at this point existed before the glacial epoch, and was at least twenty feet below the surface of the limestone cliff on the eastern side, and probably lower near the middle.

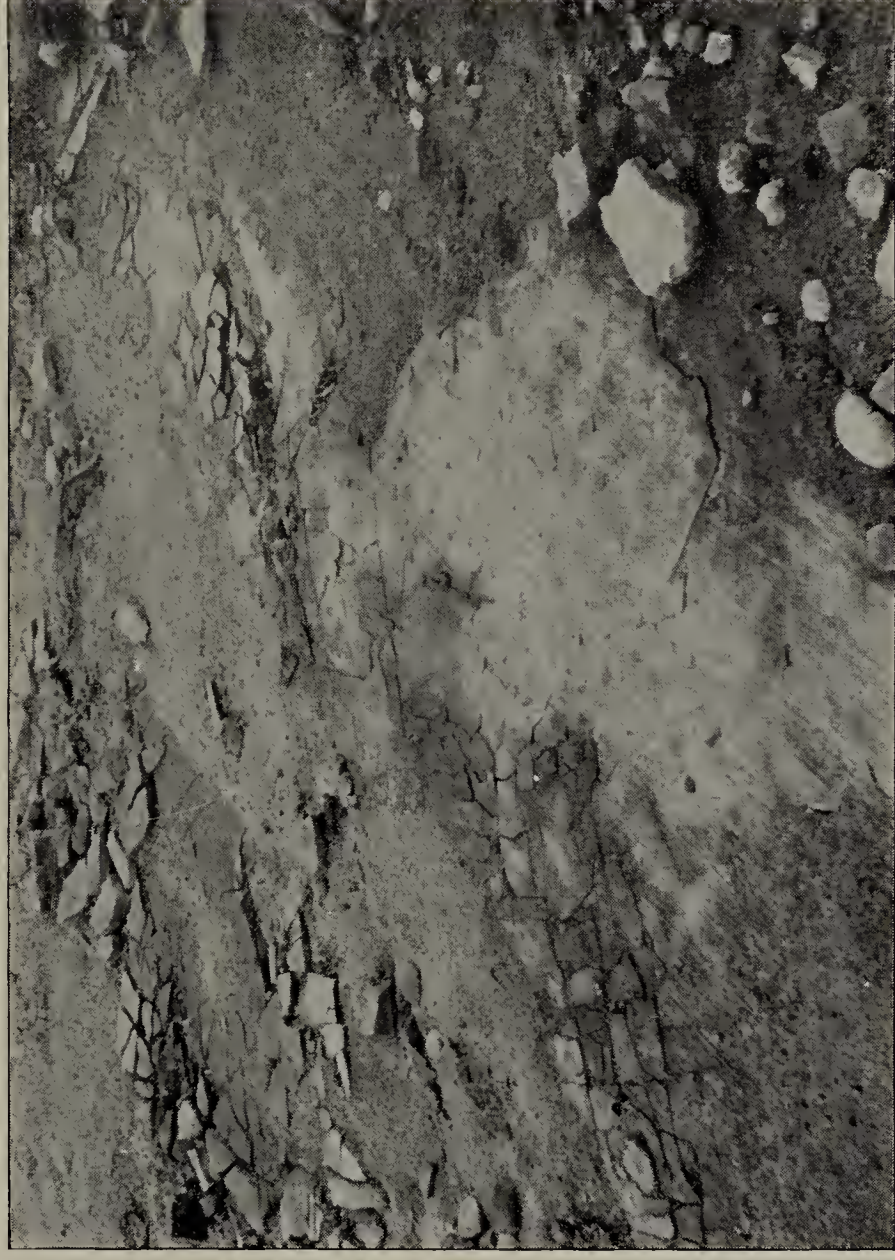
Half a mile down the river on the Canadian side, near the stone church, the water-lime is striated and smoothed by glacial action down to and beneath the water line of the river. Photographs showing these markings and those in the quarry on the American side are here given. It is certain, therefore, that the present channel of the upper Niagara cannot be more recent than the close of the glacial period, and probably was well defined to the depth of twenty feet or more before that time.

The rate of erosion going on now is difficult to estimate, very few data upon that point having been collected. In smaller streams flowing over the Corniferous limestone, the amount of erosion since the glacial period amounts to only a few inches. A view of the bed of Cayuga creek, near Bellevue, is inserted here for the purpose of illustration. The surface of the limestone under the bridge is glaciated on the right bank of the stream. Erosion has proceeded through the widening of joints, partly by the action of water, and partly through the agency of material carried along by the current. The stream is here quite rapid when at its normal height, but the depression in the channel shows that very little material has been removed. While the volume of water in the Niagara river is much greater than in the stream referred to, it is probable that erosion is there proceeding very slowly; and that a part of the central depression, where the river now is, was excavated before glacial time.

Preglacial Rivers.

It has been thought by Dr. Julius Pohlman and others, that a preglacial river of large size flowed into the depression now occupied by lake Erie at some point between the present mouth of Buffalo creek and Bay View. This opinion was based largely upon the fact that in driving piles for the Lehigh docks on the Tifft farm, the bed-rock was found to suddenly drop from about thirty-seven feet to over a hundred feet below the surface. As the rock to the northward was known to be Corniferous limestone, it was argued that a stream of larger size than Buffalo creek was necessary to erode

PLATE VII



GLACIAL MARKINGS IN THE BED OF THE NIAGARA RIVER, CANADIAN SIDE, AT FORT ERIE

a rock of such durability to the depth shown by the excavations. Since the matter is of considerable local interest, I have looked over the ground very carefully for evidences of such a stream, and have collected from contractors engaged in sinking piles, drilling and dredging, considerable data regarding the surface of the bed-rock.

The existence of a great river at any time near the present site of Buffalo creek or between there and Bay View is negatived by the appearance of rock at or near the surface in the places where this supposed river must have flowed. Stone has been quarried near Seneca and Chicago streets and at Bailey avenue and the New York Central railroad crossing; it crops out in the brick-yards on Clinton street near Bailey avenue, and at the end of Clinton street. It is found near Winchester, in Cazenovia park, and in several places between there and South park. It also is found in Smoke creek below West Seneca. Farther away from Buffalo, the outcrops of rock are so continuous as to preclude the possibility of a stream which, in its upper course, did not flow over approximately the same bed as one of these existing. At the Snow Steam Pump Works, near Buffalo creek, the limestone was found at fifty-two feet. The wells at the Atlas Oil Refinery and the Chemical Works touched it at about the same depth. At the upper end of the Hamburg canal, the distance to rock is twenty-three feet, and at the lower end twelve to fifteen feet. At the Glucose Works it was forty-two feet. Along the Ohio basin, on the south side, the drift is from twenty-six to thirty-seven feet deep, dipping towards the Lehigh docks. Mr. J. H. Leh informs me that the piles were driven here six feet apart from north to south, and that each pile had to be made a foot longer than the preceding one to reach bottom. The southern limit of the Corniferous limestone appears to be near these docks. At the railroad bridge across the Blackwell canal, on the side next the lake, the piles were driven to the depth of 120 feet without touching bottom. From the Hamburg turnpike bridge to the foot of Michigan street along the creek and canal in the vicinity of Ganson street, there is no rock nearer the surface than eighty or ninety feet. It is probable that this depression is continuous with the 120-foot depth at the railroad bridge and lies nearly at right angles with the general course of Buffalo creek at this point.

Within a few years the United States engineers have made a series of borings to ascertain the nature of the bottom between the southern end of the breakwater and Stony Point. The borings were 400 feet apart and approximately 1,000 feet from the shore, passing through the lacustrine deposits to

rock-bottom. Between the end of the breakwater and a point opposite the Lehigh docks, the distance from the surface of the lake to bed-rock was from fifty-three to sixty-one feet. Sixteen hundred feet further on, the bottom was seventy-one and one-half feet below the surface, with a rise to fifty-nine feet within two stations. The deepest depression lies near Stony Point, where the rock was seventy-seven feet from the surface. Beyond this the rock rises quite abruptly, being only eleven feet from the surface at the last station near the shore. The lake charts show a depression in the lake bottom nearly opposite the Lehigh docks, which extends about 20,000 feet westerly into the lake. Along this, the water is about a fathom deeper than on either side. This depression is about 4,800 feet north of the deep depression already referred to and, of course, more recent.

From the above facts it is probable that the preglacial Buffalo creek entered the present lake depression between the present site of the Lehigh docks and Stony Point, cutting its way through soft Marcellus shales between the edge of the Corniferous and Stafford limestones.

The line where the rock suddenly drops off from thirty-seven feet to one hundred and twenty and ninety feet, is approximately the southward continuation of the bluff seen at the Front and may have had a similar origin; or it may be the extension of the southern limit of the Corniferous limestone into the lake. At present we have not sufficient data to determine this point.

There is no evidence to show that there ever was a great river here, or that the drainage before or since the glacial epoch was essentially different from that existing.

When the continent attained its present elevation at the close of the Champlain period, Buffalo creek probably made for itself a channel not very far from the old one, emptying into the lake near the present site of the Lehigh docks. The sheet of glacial clays and sand, covering the valley east of the lake to the depth of thirty to fifty feet, extended out into the lake depression, filling the ancient channel near Stony Point to about the same depth. Across this detritus the submerged current of the creek flowed, cutting a shallow channel and finally losing itself in the lake beyond. Winds drifted sand upon the beach along the lake front, forming a sand ridge higher than the land to the eastward, like that now forming. The combined action of wind and waves formed a bar at the mouth of the sluggish Buffalo creek, damming it and causing it to flow northward, the sand ridge separating it from the lake and determining its present course.

The Ancient Lake Shore Line in Buffalo.

Several deep excavations near Main street have given me, during the past summer, an opportunity of studying the stratification of the drift in the lower part of the city. The data collected, while mainly of local interest, throw some light upon the location of ancient lake levels.

In the cellar of the building on the White property, above Chippewa street, there were eight feet of sand at the surface with six feet of coarse gravel at the bottom. Both sand and gravel were laminated, the sand showing cross-bedding and the gravel beds sloping towards the lake. At the Guaranty building, corner of Pearl and Church streets, borings were made to ascertain the depth of bed-rock. According to the contractors, Messrs. Brown & Stebell, the drill passed from the level of the curb through

Loam 5 or 6 feet.

Sand and gravel to 52 "

The cellar of the Ellicott square building was excavated to the depth of nineteen feet, and three borings were made twenty feet deeper without finding rock. Sand to the depth of five feet was found in the corner between Main and South Division streets, extending about two-thirds of the way to Swan along Main, and about half-way to Washington along South Division street. Below the sand and covering the rest of the cellar bottom was clay, the lower part containing boulders.

In the grade-crossing work at Main street and the Terrace, piles were driven on the east side of Main street to the depth of thirty feet, stopping in boulder clay. On the opposite side of the street the piles were sunk to twenty-four feet. At the bottom the soil was very hard, the pile yielding only a quarter of an inch at each blow of the hammer. Near the liberty pole, the excavation showed clean sand on the upper side, and filling of rubbish, brick, etc., on the lower. Here was probably the original terrace from which the street took its name. From here to Pearl street was almost clean, fine sand, cross-bedded and laminated, showing the action of wind. From Pearl to West Seneca street, the bottom of the cut was through coarse gravel showing beach action of water.

Mr. C. D. Zimmerman informs me that within the recollection of his father the land below the Terrace was a swamp, and before the erection of the breakwater was flooded during heavy gales, up to where the Mansion House now stands, at the corner of Main and Exchange streets. The maps of the United States survey give the elevation at Exchange and Main streets as 600 feet above tide, or approximately twenty-seven feet above

the surface of the lake. The 600-foot contour line from this point passes through Niagara square, keeps within a block of Niagara street on the east side as far as Maryland street, and there bends toward the lake again. It is quite evident that the sand deposits to the eastward of this are dunes formed by the wind, like those seen at Crystal beach, on the Canadian side, and may have travelled some distance from the original beach. The gravel deposits at West Seneca street and the Terrace, indicate that as an approximate ancient shore line and go to show that the lake has not subsided more than fifteen feet within the recent period. It is a curious fact that no shells or animal remains are found in any of the sand or gravel beds about the city.

Modern Geologic Changes.

Mr. David F. Day informs me that old maps and prints of the vicinity of Buffalo show islands near the head of the Niagara river between Horse-Shoe Reef lighthouse and the site of the present breakwater. The existence of such islands is also confirmed by the testimony of an acquaintance of his, an old resident, who remembered seeing them. At present, their site is marked by shoals covered by three to five feet of water. It is probable that the wind was the most active agent in effecting their destruction.

ECONOMIC GEOLOGY.

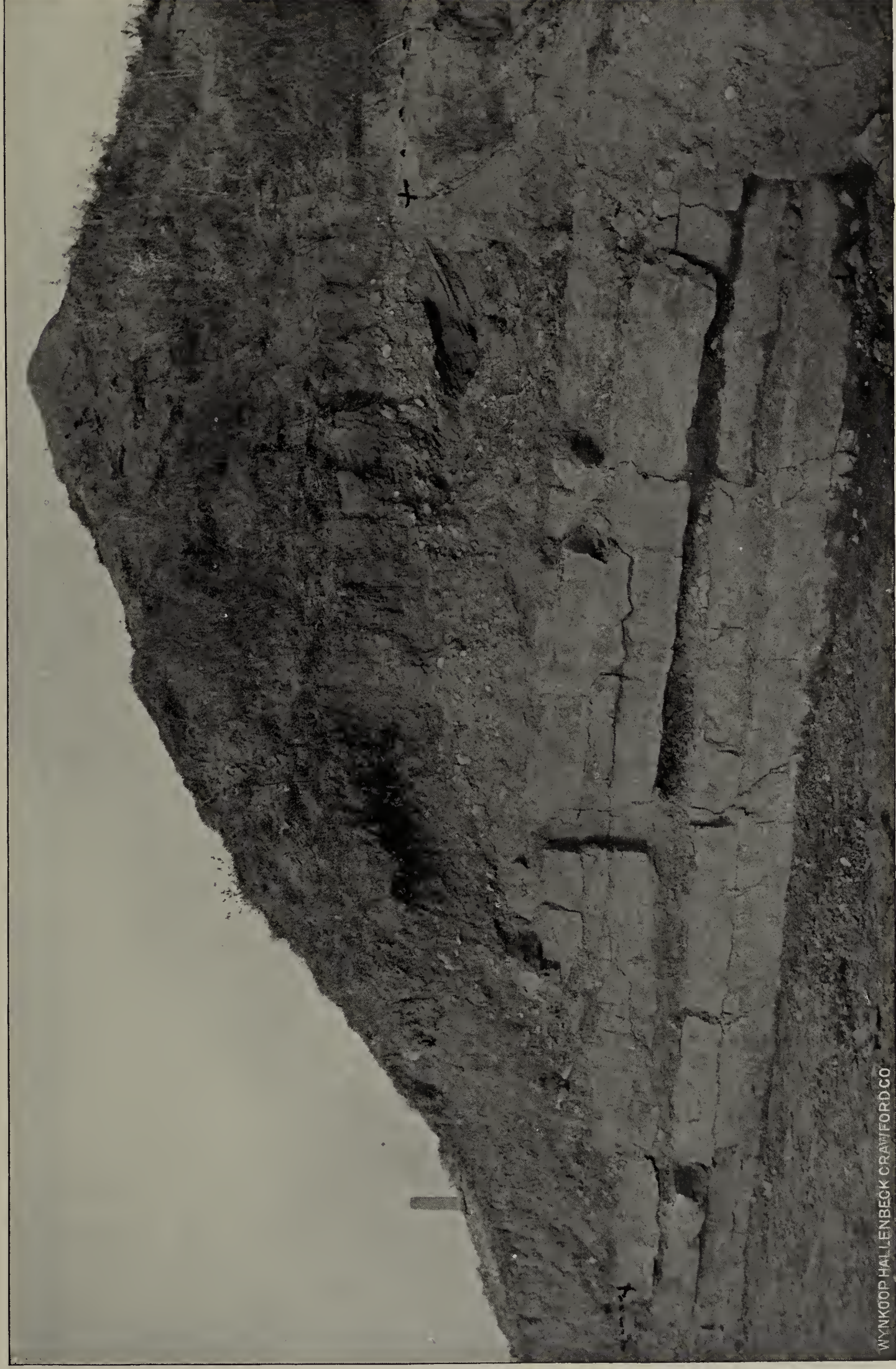
Stone Quarries.

The geologic formations which furnish stone suitable for building or bridge work within the limits of the county, are the following :

- (1) The Hydraulic limestones.
- (2) The Onondaga limestone.
- (3) The Corniferous limestone.
- (4) The Stafford limestone of the Marcellus beds.
- (5) The Encrinal limestone of the Hamilton beds.
- (6) The sandstones of the upper Portage.

The Hydraulic Limestones. The northern edge of the Corniferous limestone, together with the Onondaga limestone and the underlying water-lime, forms a more or less well-defined escarpment, extending from Buffalo through Williamsville, Clarence and Akron to the Genesee county line. In this whole distance there is hardly a mile in which stone has not been quarried for sale or local use. Since the face of the escarpment shows all three formations, they are usually quarried and sold together, so that the amount of hydraulic and Onondaga limestone used for building purposes cannot be separately

PLATE VIII



QUARRY IN CORNIFEROUS LIMESTONE, AT THE FRONT, BUFFALO. GLACIAL MARKINGS AT A AND B.

determined. At the works of the Buffalo Cement Co., at Buffalo, the overlying Corniferous, Onondaga, and a part of the water-lime are removed to reach the cement stratum. The best of these strippings are sold at the quarry for building purposes, and the company has just erected a crusher for converting the chips and refuse into road metal. The relation of these rocks in the last-named quarry may be seen from the following section :

Top; Flint and limestone, Corniferous,	3	to	9	feet.
(6) Onondaga limestone,	5	"	8	inches.
(5) Loose friable limestone,	0	"	6	"
(4) Shale with gypsum crystals,	0	"	2	"
(3) Hydraulic limestone, porous, locally known as "bullhead,"	7	"	0	"
(2) Cement rock, used for burning,	5	"	8	"
(1) Bottom, of impure hydraulic limestone.				

The "bullhead" stratum furnishes the greater part of the water-lime used for building purposes. It is light chocolate to yellowish white in color, and filled with cavities, irregular in shape, and ranging from the size of a kernel of corn to an inch or more in diameter. On account of its porosity, water and gases pass readily through this stone, and it is, therefore, not in favor for cellars or similar work.

The Onondaga Limestone. This formation expands near Williamsville into one or two lenticular masses from which it is quarried by R. & H. Fogelsonger and J. S. Young. Being composed almost exclusively of the remains of corals, crinoids and mollusks, it is of exceptional purity, as is seen from the following analysis by Hugo Carlson, of the Johnson Laboratory, Johnstown, Pa. The specimen was from the Fogelsonger quarry.

Carbonate of lime,	96.54
Carbonate of magnesia,	1.00
Alumina and oxide of iron, . . . . .	.84
Silica,	1.17
Sulphur, . . . . .	.101
Phosphorus, . . . . .	.017

This stone cuts easily and is used for trimmings for buildings, water-tables, lintels, etc. A small amount is also sold for smelting purposes. The chips and waste are burned for lime. The two quarries sold last year 260 cords of building stone and 85,000 cubic feet of dressed stone. At Fogelsonger's quarry the limestone has been removed to the depth of twenty feet, and the thickness of the remaining part, as shown by drillings from a well in

the quarry, is fifteen feet, making a total thickness of thirty-five feet. The rock at the Young quarry is of about the same thickness.

About 150 feet north of the Fogelsonger quarry, is another known as the "Syndicate" quarry, owned by Louis Wild, Joseph Mayer and Henry Smith, of Buffalo. At present the quarry is not worked.

The Corniferous Limestone. This formation furnished the greater part of the stone quarried within the county. The largest quarry interests are located within the limits of the city of Buffalo, and comprise two districts. The first includes the quarries near Main street, from the Almshouse to the Buffalo Cement Works. These are at present idle with the exception of the Grattan & Jennings quarry, which is selling a small quantity of stone. The second district, locally known as "Jammerthal," includes the region on both sides of Fillmore avenue, from LeRoy avenue to Delavan, and extending east along LeRoy to Worcester place, and along Delavan avenue to Dutton. The limestone is very cherty, and on that account hard to cut, but makes a very strong and durable building material. The layers are from twelve to twenty-four inches thick, and blocks can be obtained of almost any desired size. For this reason the stone is well adapted for railroad bridges, footing for piers and for other heavy work. It is also the principal material for cellar and foundation work for buildings of all sorts. The greater part of the stone quarried here is used in Buffalo and by the railroads which enter this city.

Besides the quarries already mentioned, there is a small one belonging to Cutter & Bailey near the New York Central railroad and Bailey avenue. Another, from which a few cords have been taken during the past season, is near the canal, just below the railroad bridge at the Front.

The greater number of quarries within the county, and outside of the city of Buffalo, are located near the southern edge of the Corniferous outcrop. The limestone contains less chert and is somewhat thicker bedded. The following section of Martin Keiffer's quarry, near Depew, illustrates very well the conditions which exist at that horizon. The quarry is situated near the north bank of Cayuga creek.

- (1) Top, fine sand, 48 inches.
- (2) Alluvium containing limbs of trees, 24 "
- (3) Surface of rock, rough like bed of stream,
- (4) Layer of limestone, 24 "
- (5) Layer of limestone, 45 "
- (6) Layer of soft calcareous shale, 3 "
- (7) Layer of limestone, 18 "

PLATE IX



WYNKOOP HALLENBECK & PAWELORD CO.

STREAM EROSION OF CORNIFEROUS LIMESTONE, CAYUGA CREEK, NEAR BELLEVUE.
THE ROCK IN THE LEFT FOREGROUND HAS BEEN REMOVED BY BLASTING.

- (8) Layer of limestone, 12 inches.
 (9) Layer of limestone, $4\frac{1}{2}$ "
 (10) Layer of limestone, 14 "

Glacial scratches appear at the eastern end. The rest of the exposed edge is old, roughened creek-bottom. Statistics regarding the foregoing quarries will be found tabulated on a following page.

The Stafford Limestone. This rock furnishes a stone of good quality suitable for building or bridge work. It has been quarried in the bed of Buffalo creek at the end of Winchester avenue, below Gardenville, and at Lancaster. The only quarry from which stone has been taken during the past year is that of George Bingham at the latter place. No record has been kept of the quantity, which is not considerable.

The Basal Limestone. This stone has been quarried in a small way in the creek below the dam at Blossom. It is used there for foundations and to some extent in the abutments of the bridge across the creek.

The Encrinal Limestone. Since this limestone consists of one or two thick layers of a durable stone it has been quarried for culverts and abutments of bridges all along the outcrop. Owing to the limited quantity in sight at any one place, the supply has been largely exhausted except in ravines difficult of access. The only open quarry of consequence is in the valley of Buffalo creek, between Elma and Marilla. The quantity quarried here was not learned.

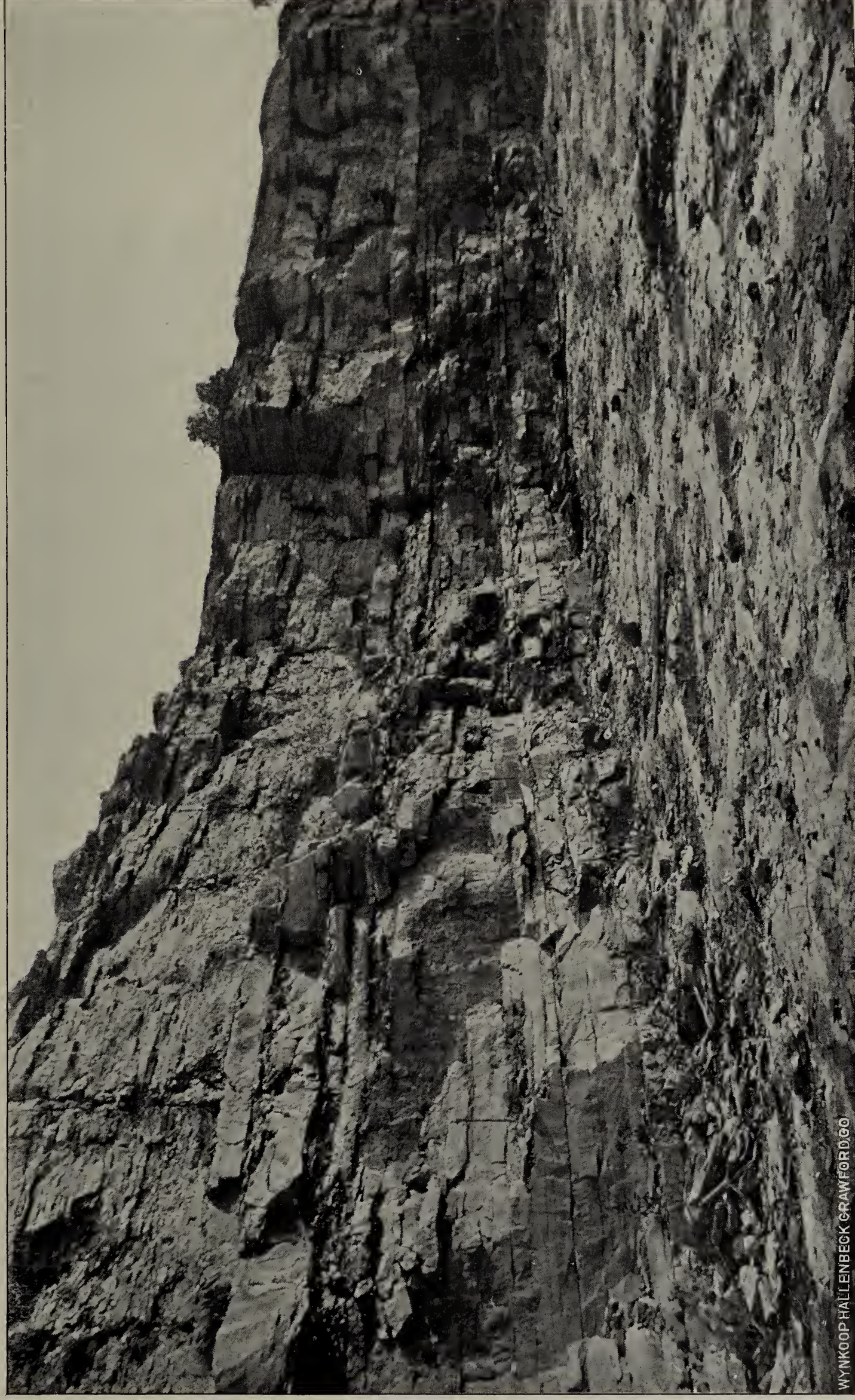
The Portage Sandstones. Although, as has been elsewhere shown, Portage bluestone of good quality is quarried in several places, no attempt has been made to utilize it farther than to supply immediate local demands. This is chiefly due to the fact, that Buffalo, the nearest market, is supplied with durable stone from its own quarries, or gets it cheaply from a distance by means of excellent lake and railroad facilities. In addition to the quarries here tabulated, the following were noted which were either not in operation or from which no statistics could be collected:

Phelps,	2 miles southwest of East Aurora.
———	East of Griffins Mills.
Joseph Myers,	2 miles east of Wales Center.
Ulrich,	$1\frac{1}{4}$ miles southwest of Wales.
Charles M. Brayton,	South Wales.
Zeller,	4 miles north of Boston Centre.
Pike and Townsend hills, .	3 miles southwest of Boston Corners.
Daniel Sherman,	2 miles northeast of Collins.

QUARRY OWNERS AND PRODUCT, CITY OF BUFFALO.

QUARRY OWNERS.	ADDRESS.	LOCATION OF QUARRY.	KIND OF STONE.	AMOUNT.	GEOLOGIC FORMATION.	REMARKS.
Grattan & Jennings.....	D L. & W. freight house, foot of Main st.....	Amherst st. near .. L. & W. railroad.....	Dimension and bridge...	700 cords in '93 ..	Corniferous	Only 70 cords in '94.
Buffalo Stone and Cement Co	Buffalo.....	Main st. near Erie railroad ..	.....	.....	Cornif. Onondaga and wate-lime	Not worked at present.
Forest Lawn Cemetary.....	Buffalo.....	Forest Lawn Cemetery ..	Building and bridge	1,400 cords	Cornif. Onondaga and water-lime	Also make road metal.
.....	.....	Front near N. Y C railroad ..	Heavy building	25 cords	Corniferous.....	.....
John J. Gesl.....	317 Leroy ave.....	Kensington near Fillmore ..	Building and railroad bridge	500 cords	Corniferous.. ..	.....
Manser	Buffalo	Leroy ave. near Worcester pl.	Building .....	.....	Corniferous.	Not worked at present
Leroy Stone Co	Buffalo	Leroy ave near Worcester pl.	Building .....	.....	Corniferous.	Not worked at present.
E. J Ambrose	2135 Fillmore ave	Kensington near Worces-ter pl	Building and dimension.	500 cords	Corniferous.....	.....
C Uebelhoefer....	.....	Kensington near Fillmore ..	Building and bridge.....	2,400 cords	Corniferous.....	.....
Anna Gehres.....	1968 Fillmore ave	Kensington near Fillmore ..	Building and dimension.	5,000 cords	Corniferous. ....	.....
Cutter & Bailey....	143 Washington st	Fillmore near Appenheimer ..	Building and dimension.	3,000 cords	Corniferous.....	Have also small quarry on Bailey ave.
H. Friedman	185 High st	Fillmore near Appenheimer...	Building and dimension	2,000 cords	Corniferous.....	.....
Schumacher & Liederman ...	Fillmore near Appenheimer	Fillmore near Appenheimer...	Building and dimension.	.....	Corniferous.....	Just begun work.
John L Appenheimer.....	Appenheimer near Fillmore	Appenheimer near Fillmore ..	Building and dimension.	.....	Corniferous	Not worked at present
Sébastien Schrier	285 Herman.....	Appenheimer near Fillmore ...	Building and dimension	1,200 cords	Corniferous ...	Leases quarry
Chas. Steinwach.....	.....	Delavan and Fillmore ave ..	.....	.....	Corniferous.....	No report.
Barber Asphalt Co	Austin Block	Fillmore near Appenheimer ...	Building	2,000 to 5,000 cords.	Corniferous. ..	Also make road metal.
Buffalo Cement Co .....	.....	Main st. near Belt line ...	Building .....	.....	Cornif. Onondaga and water-lime	No record kept.

PLATE X



SUCCESION OF THE STRATA IN BUFFALO CEMENT QUARRY, BUFFALO.

A, CORNIFEROUS LIMESTONE; B, ONONDAGA LIMESTONE; X, LOOSE LIMESTONE AND SHALE; C, "BULL-HEAD" ROCK; D, CEMENT ROCK.

WYNKOOP HALLENBECK CRAWFORD & CO.

QUARRY OWNERS AND PRODUCT IN ERIE COUNTY OUTSIDE OF THE CITY OF BUFFALO.

QUARRY OWNERS.	ADDRESS.	LOCATION OF QUARRY.	KIND OF STONE.	AMOUNT.	GEOLOGIC FORMATION.	MARKET.
R. & H. Fogelsonger.....	215 Oak st , Buffalo ..	Williamsville...	Building and cut.....	200 cds building 85,000 cu ft cut	Onondaga limestone	Buffalo.
J. S Youngs.....	215 Oak st., Buffalo.....	Williamsville	Building	60 cords ..	Onondaga limestone	Buffalo.
H. L. & W. C. Newman.....	Akron	Falkirk	Building	100 cords	Onondaga, Corniferous and water-lime	Local.
J Bieler ...	Clarence Centre.....	Clarence Centre ...	Building	50 cords	Onondaga and Corniferous.....	Local.
John Hiller.....	Mill Grove ...	Mill Grove.....	Bridge and culvert .....	.....	Corniferous	Town of Alden.
M Souther.....	Cheektowaga	Cheektowaga	Building and culvert	100 cords	Corniferous....	Local,
Lawrence Kaeser	Cheektowaga	Cheektowaga.....	Building and culvert	100 cords	Corniferous	Local.
Nicholas Setter	Cheektowaga	Cheektowaga	Building and culvert	100 cords ..	Corniferous	Local.
Martin Kieffer	Depew	Near Transit road.	Building and dimension.....	600 cords	Corniferous	Local.
Buffalo, Bellevue & Lancaster R.R. Co	Bellevue	Belevue	Railroad bridge and dimension	.....	Corniferous .....	.....
A. Eyrsmann.....	Wilhelm	Wilhelm	Building and bridge.....	350 cords	Corniferous	Local.
A W. Haskell	Bowmansville.....	Bowmansville ..	Bridge	225 cords in '94	Corniferous	Local.
Ernest Bowen	Bowmansville.....	Bowmansville ..	Bridge	125 cords in '94	Corniferous	Local.
Straub & Meyer	480 Hamburg st., Buffalo .	Gunnville	Building	1,000 cords	Corniferous	Buffalo.
Geo. Bingham	Lancaster	Lancaster	Building .....	.....	Stafford limestone	Local.
W C. Cook.....	East Aurora	East Aurora. ...	Building	150 cords	Portage sandstone	Local
Delavan Caulkins ..	East Aurora.....	East Aurora	Building	200 cords	Portage sandstone	Local.
F. A. Clarke	Springville	Springville	Building	25 cords ..	Portage sandstone	Local.
Mrs. B. Wheeler	Springville.....	Springville .	Bridge	200 cords	Portage sandstone	Local.

Road Metal.

Large quantities of crushed stone are used in Buffalo by the different companies engaged in laying asphalt pavements, concrete sidewalks and concrete work generally. It is used as the foundation of all asphalt pavement, of which the city now has over 200 miles. When a stone pavement wears out, it is, as a rule, replaced by asphalt. In this case, the old blocks, usually of Medina sandstone, are crushed on the spot and used as the basis for the street pavement. Chips from the Medina sandstone quarries in Orleans county are also crushed and sent in by canal so cheaply as to compete strongly with the home product. It is, therefore, very difficult to estimate closely the amount consumed in the city. The Corniferous limestone is generally preferred to the Medina sandstone, for the reason that it is less absorbent, both of water and of paving material. For macadam pavement it is used entirely, the flint furnishing a substance which is very enduring, and the limestone serving to pack it firmly together. Neither of these materials splits readily or breaks up under hoofs or wheels. It makes, also, excellent ballast for railroads and is used for that purpose by some of the suburban electric railways. The Buffalo, Bellevue and Lancaster railroad has a crusher at Bellevue which furnishes ballast for that road and a large amount for surfacing the streets of Depew. The Buffalo Cement Co. have recently erected a steam crusher with a capacity of 450 yards a day, in which waste from their quarries, particularly the cherty rock from the edge of the Corniferous limestone, is reduced to road metal. The rock is wheeled in barrows directly to the mill, where it is crushed, screened and loaded by chutes directly into cars for shipment without further handling. The finer grades are used in concrete work, and the coarser are sold as ballast. The Barber Asphalt Co. has the largest plant in the city, at Fillmore avenue, near Appenheimer, where its quarries are located. It consumes the greater part of the product, but sells some to other parties. The Park commissioners have a crusher at the Central Park quarry, in which road metal for the park roads is prepared. During 1895, however, they purchased their supply of the Barber Asphalt Co. The Forest Lawn cemetery has a crusher in which material for the cemetery walks and drives is prepared. The stone is obtained from a quarry on the north side of the enclosure.

Statistics regarding road metal will be found in the following table:

PLATE XI



WYNKOOPHALLENBECK CRAWFORD CO

THE ONONDAGA LIMESTONE, FOGELSONGER'S QUARRY, WILLIAMSVILLE.

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PRODUCERS OF ROAD METAL.

MANUFACTURERS.	ADDRESS.	CAPACITY PER ANNUM.	PRODUCT PER ANNUM.	USE.	REMARKS.
Barber Asphalt Co	Buffalo	100,000 cu. yds.....	80,000 cu. yds..	For paving.....	.....
Buffalo Park Commissioners.....	Buffalo .....	.....	6,000 cu. yds..	For park roads	Statistics for '93. 1,500 yds. in '94. None in '95.
Forest Lawn Cemetery.....	Buffalo .....	.....	1,000 cu. yds	For cemetery roads and paths .....	.....
Buffalo Cement Co	Buffalo	450 cu. yds. per diem.	.....	For railroad ballast, concrete and roads	Crusher just erected.
Buffalo, Bellevue and Lancaster railroad..	.....	.....	.....	.....	No information received.

Hydraulic Cement.

Historical. As Erie county was among the earliest producers of hydraulic cement, the following facts, taken largely from "A History of Buffalo and Erie County, New York," by H. Perry Smith, are of interest:

The first cement manufactured in the county was made at Williamsville about the year 1825*, the quarry, kiln and mill being near the creek. In 1839, Jonathan Delano erected works at Falkirk, near Akron, in which he made about 2,000 barrels of cement the first year. He furnished the cement for the feeder dam at Tonawanda creek and for the Genesee valley canal. In 1843, the business passed into the hands of James Montgomery, who increased the output to 10,000 barrels a year. The business afterwards came into the possession of Enos Newman, a partner of Montgomery, and has been in his family ever since.

In 1854, H. Cummings & Son established a cement factory at Akron, which was operated for several years, and was succeeded in 1865 by another, managed by his sons. This was sold to the Akron Cement Co. in 1870-71, and the Cummings brothers erected another factory about two miles west of Akron. Since then it has been enlarged, until now it is one of the most complete in the state.

The first cement made in Buffalo was manufactured by Warren Granger near Scajaquada creek, in what is now Forest Lawn cemetery.

Regarding this, Mr. Uriah Cummings, to whom I wrote for information, says: "Warren Granger told me some twenty years ago that he started in making cement in Forest Lawn just below the Main street bridge, at which time, 1850, what is now Forest Lawn was his own farm."

In 1874, Lewis J. Bennett began the manufacture of cement at Buffalo Plains, near Main street. The business which has been carried on continuously ever since, is now in the hands of the Buffalo Cement Co., of which Mr. Bennett and his sons are officers.

Mining and Manufacture. The stratum of water-lime burned for cement varies in thickness from five to eight feet. It is a firm, fine-grained, compact rock of a blue-grey color, sometimes with a yellowish tinge, and weathering to a yellowish white. Three out of the four companies which manufacture cement obtain the rock by mining. The method employed at the Cummings Cement Works, at Akron, illustrates very well the process of preparing cement for market. The stratum is here seven feet thick, cropping out on the face of

* Mr. Uriah Cummings, who has looked up the matter very carefully, gives this date as 1824.

PLATE XII



WYNKOOP HALLENBECK CRAWFORD CO.

WORKS FOR MAKING ROAD-METAL ; BUFFALO CEMENT COMPANY, BUFFALO.

a high cliff some distance above the base. The cutting is made horizontally into the rock, pillars being left to support the roof. The drills are run by compressed air furnished by five pumps located near the mouth of the mine. Blasting is done with black powder, trams convey the rock to the kilns, where it is calcined and then ground by what is called the gradual reduction process. The calcined rock is passed through four mills, being screened after each grinding. The cement is then packed in bags and barrels for market. It is largely used for sewers, the foundation for asphalt pavements, cellar-bottoms and concrete work generally. This company furnished 600,000 barrels for a single contract, the building of the new aqueduct for New York City. The officers of the company are: President, Uriah Cummings; Vice-President, R. P. Cummings; Treasurer and Manager, P. Cummings; Secretary, Homer S. Cummings.

The works of H. L. & W. C. Newman are located at Falkirk, where they own 200 acres of cement rock. The stratum is here seven and one-half feet thick. The rock is mined as at the Cummings works. For blasting, dynamite is used instead of powder, and soft coal is used for calcining. They make from 135,000 to 140,000 barrels yearly.

The Akron Cement Works, at Akron, have 225 acres of land adjoining that of the Newmans, with a cement stratum eight feet thick. The rock is obtained by mining. One of the old workings is utilized for the growing of mushrooms, the uniform low temperature and darkness furnishing the necessary conditions for their growth. The officers of this company are: President, Hon. D. N. Lockwood, Buffalo: Secretary and Treasurer, Frank S. Coit.

The Buffalo Cement Co. has its quarries on Main street, near the Belt-line of the New York Central railroad. Blasting is done with black powder. Since the city is rapidly extending in that direction, coke is used as fuel to avoid objectionable smoke. The overlying rock is quarried and sold for building purposes and the refuse crushed for road-metal, thus minimizing the cost of stripping. A section of the rock exposed by the stripping is given elsewhere. This quarry is famous for the number and excellence of crustacean remains found in it. These occur almost exclusively in the cement stratum, and of course are obtained only when that is being worked. Mr. Fred K. Mixer, director of the museum of the Buffalo Society of Natural Sciences, has prepared for me the following list of species found in the hydraulic limestones near Buffalo, the greater number of which are from the Buffalo Cement Co.'s quarry:

Merostomata.*Eurypteridae.*

Eurypterus giganteus, Pohlman.

Eurypterus lacustris, Hall.

Eurypterus lacustris var. *robustus*, Hall.

Eurypterus remipes, DeKay.

Eurypterus pachychirus, Hall.

Eurypterus DeKayi, Hall.

Eurypterus (*Dolichopterus*) *macrochirus*, Hall.

Eurypterus (*Eusarcus*) *grandis*, Grote and Pitt.

Eurypterus (*Eusarcus*) *scorpionis*, Grote and Pitt.

Pterygotidae.

Pterygotus Buffaloensis, Pohlman.

Pterygotus Cummingsi, Grote and Pitt.

Pterygotus bilobus, Huxley and Salter.

Pterygotus globicaudatus, Pohlman.

Pterygotus microphthalmus, Hall.

Pterygotus quadraticaudatus, Pohlman.

Pterygotus acuticaudatus, Pohlman.

Since the last named species was described, several specimens of it in a good state of preservation have been obtained, showing almost the entire animal. One in the museum collection shows all but the posterior end of the body with two-thirds of the tail. One set of antennae is preserved, and also portions of the swimming feet. This specimen is only a foot in length, but was probably a young animal.

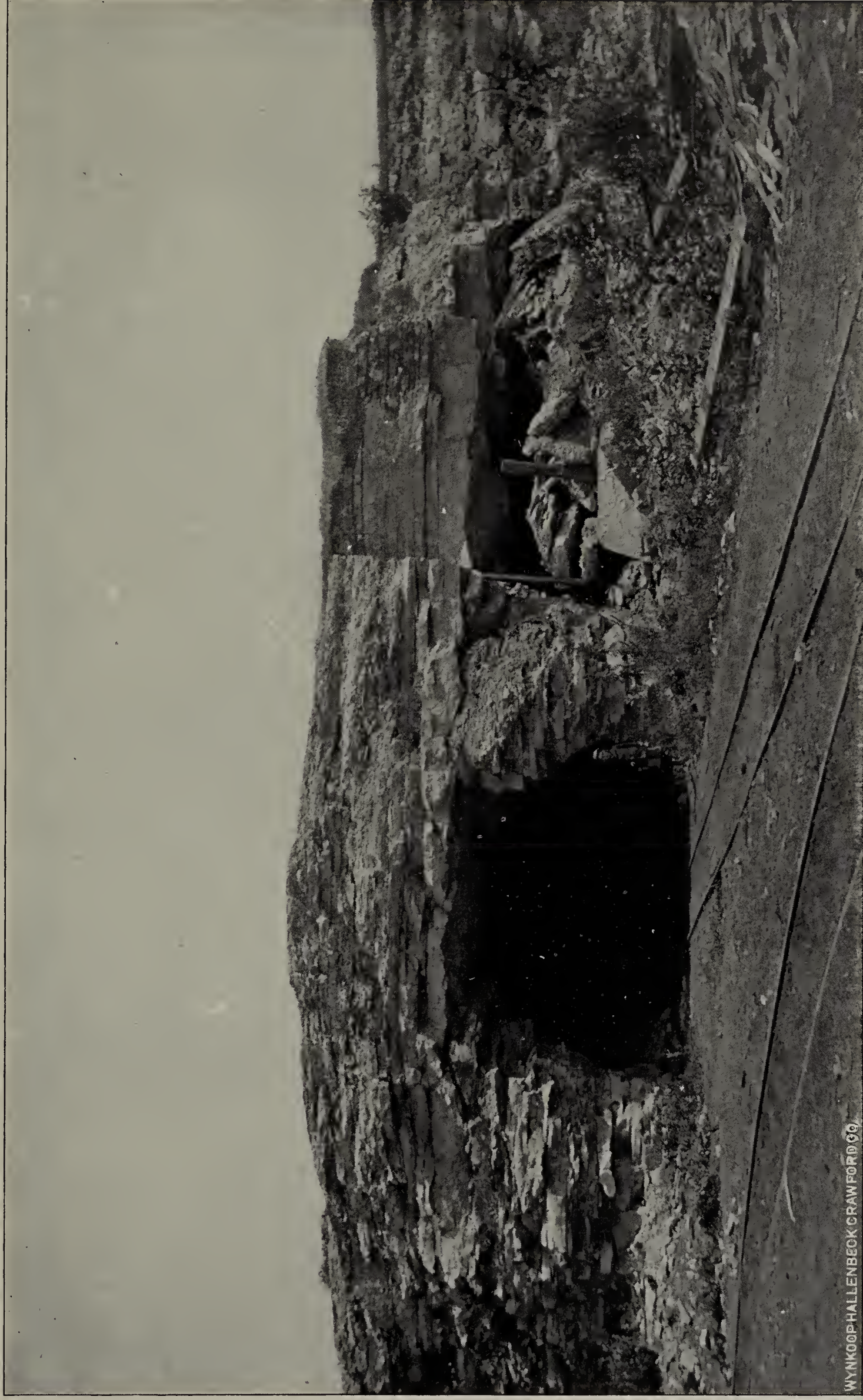
Phyllocarida.*Ceratiocaridae.*

Ceratiocaris grandis, Pohlman (specimen nine and one-half inches wide by five and one-quarter inches long).

Ceratiocaris acuminata, Hall.

Since the description of the last named species in the Bulletin of the Buffalo Society of Natural Sciences, vol. 5, a specimen has been found and is now in Mr. Mixer's possession, which shows the shape of the carapace very

PLATE XIII



WYNKOOPHALLENBECK CRAWFORD 1909

MINES OF THE AKRON CEMENT COMPANY, AKRON. THE ONONDAGA LIMESTONE IS SEEN CAPPING THE OPENING

well, except the pointed extremity, the eye being very clearly seen. The body and two caudal appendages are preserved on the same slab.

Entomostraca.

Leperditia alta, Hall.

Brachiopoda.

Five forms of Discina, probably including :

Discina (ampla) grandis, Hall (?).

Discina discus, Hall.

Lingula rectilatera, Hall.

Marine Algae.

Order Floridea.

Chondrites graminiformis, Lesquereux.

Bythotrephis Lesquereuxi, Grote and Pitt.

The officers of the Buffalo Cement Co. are: President, Lewis J. Bennett; Vice-President and Treasurer, P. J. Wood; Secretary, Leslie J. Bennett. The city office is at 110 Franklin street, Buffalo.

A statement of the interests concerned in cement manufacture is given in the following table:

CEMENT PRODUCERS AND PRODUCT, ERIE COUNTY, N. Y.

MANUFACTURER.	LOCATION.	THICKNESS OF STRATUM.	FUEL.	PRODUCT PER ANNUM.
Cummings Cement Co	Akron	7 ft	Loyal Sock coal	200,000 bbls.
H. L. & W. C. Newman...	Falkirk ...	7½ ft.....	Soft coal	135,000 to 140,000 bbls.
Akron Cement Co	Falkirk ...	8 ft.....	Soft coal	140,000 bbls.
Buffalo Cement Co	Buffalo	5 ft. 8 in.....	Coke	300,000 bbls.

Quicklime.

The lime produced within the county is made from the Onondaga and Corniferous limestones. From the former, lime of excellent quality is burned in the kilns of R. & H. Fogelsonger, at Williamsville, and in those of J. S. Young, about a mile northeast of that village, the product of both being marketed together. Wood is used for fuel. aided somewhat at the

Fogelsonger kiln by natural gas from wells on the premises. The product marketed last year amounted to 20,000 barrels. The office of the company is at 215 Oak street, Buffalo.

The Consumer's Lime Co., Straub & Meyer, lessees, has three large kilns at Gunnville, N. Y., on the West Shore railroad. The rock is obtained from an outcrop of the Corniferous limestone about midway between its northern and southern boundaries. Crude petroleum from Ohio and Pennsylvania is used for fuel, and the kilns are kept running all the year round. In 1893 the product amounted to 30,000 barrels, the greater part of which was consumed in Buffalo. During the present year the output has been diminished, on account of the financial stringency which has lessened the demand for lime; but they were unable at the office to estimate how much the product had fallen off. The city address is 480 Hamburg street, Buffalo.

There is a small lime kiln at Harris hill, owned by A. Fiegel, which burns lime chiefly for local consumption. It has a capacity of one hundred barrels in twenty-four hours, but is not kept burning all the time. The fuel here is wood.

About half a mile north of Mill grove, at the east side of the road, is a small kiln, owned and operated by Mr. Shaw. Lime is burned here for neighborhood use whenever it is needed.

The preceding are all the lime kilns now in use within the county. Remains of old kilns were noticed in several places, notably at Young's old quarry, northeast of Williamsville; another about a mile north of that, near the Transit road; one east of Harris hill, on Main street, and one about two miles north of Crittenden, on the road to Falkirk.

Brick, Tile and Fire-Proofing.

While manufacturers generally use clay as the raw material from which to make the above products, two firms manufacture directly from shale. The rock selected in both cases is an olive shale of the Portage group lying, in one instance, above, and in the other instance below the lowest divisions of the Portage sandstones. The Jewettville Pressed Brick Co. grinds the shale in a mill. The product, having about the appearance and consistency of dry road dust, is then pressed in moulds with a Boyd machine, which gives a pressure of about three tons on four bricks. The firing is done in continuous, double down-draft kilns, of which four are used. The fuel is soft coal. From 10,000 to 12,000 is the usual make per day. The total output for a year was not learned. The plant is owned by Smith & Brush.

PLATE XIV



WYKOPHALLENBECK CRAWFORD CO

KILNS OF THE BUFFALO CEMENT COMPANY, BUFFALO.

John Lyth & Sons, 48 West Eagle street, Buffalo, have extensive works at Angola, in which the raw material used is shale. The rock is ground, moistened, pressed through the dies, dried and burned in dome-shaped, down-draft kilns. Mr. Lyth has furnished me the following statistics regarding the product of these works from October 1st, 1894, to October 1st, 1895 :

Drain tile,	335,000 pieces.
Weight,	1,407½ tons.
Building brick,	471,000 pieces.
Weight,	3,375 tons.
Fire-proofing,	652,000 pieces.
Weight,	6,300 tons.

The greater part of the above was marketed in Buffalo. He is now furnishing material for the following large buildings which are in process of erection: Real estate building, Pearl street; Matthews building, Main street; Fuchs Bros. building, Washington street; Buffalo General Hospital extension, High street; Berrick building, corner Swan and Elliott streets.

The most extensive brick manufacturing interests within the county are located in the city of Buffalo, along both sides of Clinton street, from Scoville street to Bailey avenue, and beyond Bailey avenue in the district included by Bailey avenue, Clinton and Ogden streets and the New York, Lake Erie and Western railroad. The firms within these limits are F. W. Haake and the members of the Buffalo Brick Manufacturers' association. The latter organization has offices at 927 Clinton street and No. 2 Builder's Exchange. The following statement of producers, product and capacity of works was furnished by Mr. Warren H. Brush, the secretary of the association :

Firm.	Capacity.	Made in '95.
Brush Bros.,	180 M per day.	90 M per day.
L. Kirkover,	100 " "	80 " "
George Schmidt,	60 " "	60 " "
H. Ditchler,	60 " "	40 " "
C. Berrick & Sons,	80 " "	20 " "
Schusler & Co.,	40 " "	30 " "

Total output of stock and common brick in 1895, 40,515,000.

In addition to the above, Brush Brothers have a winter plant which can produce 30 M a day. This will not be in operation the present winter. The form of kiln was not noticed in all cases. Mr. Kirkover was using seven

Berrick kilns, and C. Berrick & Sons an equal number of Colwell kilns. As far as noticed all were up-draft.

At Pine hill is an extensive plant under the management of Jewett & Reynolds. In addition to common brick, they manufacture hollow brick and tile. They have three Millington machines for common brick, one Frey-Scheckler wire-cut machine, one Turner, Vaughn & Taylor direct-action steam press, and a four-mould Simpson press, which is not now in use.

The South Buffalo Brick Co., H. Bender, manager, near Gardenville, uses a Martin brick machine, and makes about a half million of brick yearly.

The Star Brick Co., Lancaster, is working one machine this year, and making two million brick, which is less than the usual amount.

The Lancaster Brick Co., office 95 Franklin street, Buffalo, has its works near Town-line. The clay bed is there thirty feet thick. The company has one stiff clay and three soft clay machines, the former a Frey-Scheckler. Five of the kilns are up-draft and two down-draft. Drain tile, mostly flat sole, with one octagon size, are produced to the number of 200,000 yearly, and also about 500,000 hollow brick.

A brickyard has been started during the past summer by Mr. J. F. Stengel on Grand Island, about a mile below the Bedell house. It is expected to produce 3,000,000 common and stock brick per annum.

A small brickyard at East Evans, and one, owned by Mr. Charles Seedorf, at Springville, are not now in operation.

Hall & Sons, 69 Tonawanda street, Buffalo, are the only firm making fire-brick within the county. They consume about 4,500 tons of material, which is brought here principally from New Jersey, with about ten per cent. from Pennsylvania. None of the material is obtained within the county.

Sewer Pipe.

The Buffalo Sewer Pipe Co., at Black Rock, is the only firm manufacturing sewer pipe. During the past year the amount sold amounted to 600 carloads, and the increase of stock on hand over the preceding year is estimated by the company as between fifty and one hundred carloads more. Some clay is obtained from Tonawanda, but the larger part, with the sand necessary to temper it, from South Amboy, N. J. The manager of this company is Mr. N. C. Barnum.

The names of the firms engaged in the foregoing industries, with the amount of clay products, are shown by the following summary :



UPPER STRATUM OF THE CORNIFEROUS LIMESTONE, SHOWING BEDDING. LEHIGH SHEDS, CHEEKTOWAGA.

COMPANY.	CAPACITY.	BRICK.	HOLLOW BRICK AND TILE.
Buffalo Brick Mfr's Association.	68,000,000	40,515,000	.....
F. W. Haake	7,000,000	7,000,000	.....
Pine Hill.....	4,000,000	3,000,000	{ Hollow brick, 500,000 (capacity, 6 million). Tile, capacity 3 mill. 2½ in. or 2¼ mill. of 6 in.
Lancaster Brick Co	10,000,000	4,000,000	{ 200,000 drain tile, 500,000 hollow brick.
Star Brick Co .....	.....	2,000,000	.....
South Buffalo Brick Co.....	.....	500,000	.....
John Lythe & Sons .....	.....	.....	{ 335,000 pieces drain tile, 471,000 pieces building brick, 652,000 pieces fire-proofing.
Jewettville Pressed Brick .....	.....	10,000 to 12,000 per day	.....
Hall & Sons (fire brick).....	.....	900,000	.....
Buffalo Sewer Pipe Co.....	.....	.....	Sewer pipe, 650 to 700 carloads.

Sand and Gravel.

Nearly all the sand and gravel consumed in Buffalo is brought by boat from the Canadian shore of lake Erie, near Point Abino. The dunes along the American shore, from Michigan street to Stony Point, furnish a small quantity, but it is not clean, and is difficult of access. Fox & Holloway, extensive dealers in sand, estimate the amount taken from this source to be approximately 5,000 cubic yards. The deposits at Pine hill have not yielded much during the year. At Gowanda is a bank of sharp sand, especially suited for mortar, which is controlled by the Buffalo Mortar and Fibre Co. Some of the railroads have gravel banks from which they obtain ballast. The following exhibit shows the approximate product for 1895:

PRODUCER.	LOCATION OF PIT.	PRODUCT IN CUBIC YARDS.
West Shore railroad.....	Clarence	37,112
New York, Lake Erie and Western rail- road	Alden	29,300
Kelly Sand Co.....	Gowanda	10,800
Pine Hill Pits.	Pine Hill	2,000
Lake Shore.....	Near Stony Point.....	5,000

Natural Gas.

In this report I have endeavored to assemble all available information regarding the development and present condition of natural gas interests in Erie county. Recognizing the value of well records in determining the thickness of geologic formations, I have taken pains to secure as many as possible. The greater part are from the original "logs" of drillers and contractors, and, in the main, are accurate. Where no record has been kept, or if kept, lost, the data available have been given for what they are worth. These imperfect records always give a gas horizon or other geologic fact worth preserving, and usually the information of greatest economic value. With a few unimportant exceptions, the material included has not heretofore been published.

History. The first gas well put down in Erie county was sunk at Getzville in 1858 or 1859, and is said to be still furnishing a small amount of gas. Following the discovery of petroleum in Pennsylvania, more or less prospecting was carried on in the southern part of New York, and about 1860, Oil Creek parties secured leases in the town of Boston and drilled a well near Patchen. This appears to have struck a fair supply of gas; but as oil was the object sought, the gas was disregarded. About 1872 the Buffalo Gas Light Co. put down a well at their works, near the corner of West Genesee and Jackson streets, and struck a pocket of gas, which lasted only a short time. Another well was drilled near Boston Corners in 1878-79, which did not find oil or gas in paying quantities, but passed through fifty or sixty feet of rock salt. Strange to say, the owners appear not to have understood the importance of their discovery, for the well was abandoned. With salt worth \$1.50 or more a barrel, the well would have been a more profitable investment than most oil wells.

The Buffalo Cement Co. made the first systematic search for gas within the city of Buffalo in 1883, putting down a well with a diamond drill to the depth of 451 feet 9 inches. A second well was sunk in the following year near the first, but this also gave very little gas. A third well in 1887 gave a good flow of gas, and was followed by several others. Encouraged by this, in 1889, Mr. Gerhard Lang drilled a well near his brewery, at Best and Jefferson streets. A fine flow of gas was found, and many other wells were immediately started in various parts of the city. Mr. George Rochefort, directly across Best street, got an excellent well, and the Erie County Pipe Line was organized to take the surplus gas from the Lang and Rochefort wells to dwellings in that vicinity. About this time Mr. Edward L. Everson struck a good supply of gas in a well bored in the rear of 971 Jefferson street, and,

PLATE XVI



WYNKOOP HALLENBECK CRAWFORD CO.

PORTAGE SHALES ; PIPE CREEK, NEAR WEST FALLS.

with three others, organized the East Side Fuel Co. with a capital of \$20,000. The officers of this company were: President, Joseph Hottinger; Vice-President, Albert Everson; Treasurer, Edward L. Everson. This company was afterward absorbed by the Erie County Pipe Line organization. Shortly after the consolidation of the two companies, Mr. W. S. Carroll, who was a member of the Erie County Pipe Line Co., became interested in a gas well which was sunk on the Canadian side of the Niagara river, and this well was bought by the Pipe Line Co. As the supply of gas gave out at Best and Jefferson streets, other Canadian wells were acquired, until the greater part of the company's property was on that side of the river. The striking of a rich supply of gas in the Baker well at West Seneca, in February, 1891, started exploration in that vicinity.

In the following year, Philip Roth and the Argue Brothers, the latter being drillers and contractors, organized the South Buffalo Natural Gas Co. with a capital of \$300,000. The Buffalo Natural Gas Fuel Co., said to be controlled by the Standard Oil Co., gave the South Buffalo Co. financial backing, under arrangements mutually advantageous.

In August, 1895, the latter company had forty-five wells, three of which would deliver 2,000,000 cubic feet of gas a day, three more that would produce 1,000,000 feet, and thirty that would produce less than 1,000,000 feet. About the first of January, 1896, the Buffalo Natural Gas Co., which has piped the greater part of its gas from the Pennsylvania fields, bought out the South Buffalo Co., and now controls all the gas wells near Buffalo, including the Canadian fields. At present it supplies fuel to about 9,000 customers.

Well Records.

Grand Island Well. (From Mr. A. B. Williams.) At Sour-Spring grove on Grand Island, opposite Tonawanda, a well was bored a few years ago to the depth of 3,129 feet, getting very little gas but much salt water at the bottom. Bed rock was found here at sixty feet, the rock being Salina shale.

Tonawanda Well. (From Mr. A. B. Williams.) At about the time the well was bored at Sour Spring, another was sunk in the village of Tonawanda, between the canal and the tracks of the New York, Lake Erie and Western railroad, on the property of Mr. A. B. Williams. Bed rock was found at fifty feet and a very little gas at 558 feet. No more gas was found to 1,100 feet where drilling was stopped.

The Getzville Wells. (From Mr. Franklin Getz.) At Getzville, six miles east of Tonawanda, is a group of twenty or twenty-one wells, in eighteen of which gas was found. The best of these have a pressure of about 200 lbs. in twenty minutes. The gas occurs at a depth of 430 to 475 feet in a soft white rock looking like gypsum. The product of these wells is piped to Tonawanda, supplying 250 families and yielding an income of about \$7,000 a year.

Of this group, five wells are located close together near the station, and the others scattered about within three miles to the north and west. The drift here was twelve feet deep in the thinnest spot through which borings were made, and sixty-nine in the thickest, the latter being near the bed of Ellicott creek. All passed through essentially the same strata, and have similar records, barring slight local differences of dip and location. The following record of Well No. 17, located one mile west of the village, will answer fairly for the whole group. It was furnished by the contractor who drilled several of the wells, from memoranda made while the well was being sunk.

Record of Well No. 17, Getzville, N. Y. (Received from J. H. Lichtenburg, driller.)

Drift,	69 feet.
Sand and shale,	at 100 "
White sand and shale,	" 140 "
Flint shell (?),	" 170 "
Shale,	" 201 "
Salt water and sand,	" 206 "
Grey sand,	" 216 "
Shale,	" 220 "
Shale and sand,	" 225 "
Red sand,	" 230 "
Fine white sand,	" 250 "
Red sand and shale with sulphur gas,	" 265 "
Bottom of red sand,	" 270 "
Dark sand,	" 276 "
Salt water and sand,	" 285 "
Grey limestone,	" 300 "
Salt water and sand,	" 328 "
Red sand.	" 335 "

Flint shell (?) (cased to),	at 361 feet.
White sand,	" 370 "
Black sand,	" 405 "
Limestone,	" 465 "
Top of (white) gas sand,	" 474 "
Bottom of (white) gas sand,	" 481 "
Bottom of well,	" 492 "
Rock much like that at the top.	

The Blocher Wells, Williamsville. (From Mr. John Blocher.) These are located on Evans street, near the eastern end of the village. Two produce gas and the other water. In boring the last the drill passed through:

Limestone,	6 to 8 feet.
Gravel and limestone alternating in beds of 3 or 4 ft. to	125 "
Dry limestones and shales, to	500 "
Water at 75 and 125 feet; dry all the way below.	

This well was bored on the very edge of the limestone terrace, and the beds of gravel referred to were evidently crowded into crevices in the rock. Similar intrusion of gravel is seen in the quarry at the Front, in the city of Buffalo. Water in this well fills a three-inch pipe two feet above the surface of the ground, and half fills it at six feet. It is charged with sulphuretted hydrogen and some mineral matter.

The second well, lying about one hundred feet to the east of the one described, struck a strong vein of sulphur gas at 500 feet. Mr. Blocher thinks this flowed a quarter of a million feet a day on the start.

Well No. 3 is situated about 200 feet north of the others.

In this the distance to rock was	107 feet.
Top of Niagara limestone,	at 440 "
Top of Clinton limestone,	" 700 "
Top of Medina sandstone,	" 725 "
Through gas sand,	851 "
Total depth,	862 "

Cased to 165 feet. Water sufficient to fill an eight-inch pipe was found five feet above bed-rock. Twenty thousand feet of gas were found in the Clinton, but none in the Medina. Wells Nos. 2 and 3 are now together furnishing about 25,000 cubic feet of gas per day, most of which is used under the boilers at the power-house of the Williamsville and Buffalo Electric railway. (Record from driller, Mr. J. W. Stearns, Akron, N. Y.)

Well on the Brock Farm, Williamsville. (From H. H. Church, driller.)

Drift,	30 feet.
Shales and limestones,	400 "
Niagara,	90 "
Shale,	60 "
Clinton,	18 "
Red Medina (?) with a little gas,	140 "
Shale,	12 "
First white sand,	10 "
Black shale,	8 "
White, coarse Medina sand (very fair gas producer),	20 "
Red shale,	40 "
Total depth of well,	830 "
Rock pressure,	480 lbs.

Mr. Church says that the red shale in which the well stopped extends 980 feet below the white Medina.

Fogelsonger's Well, Williamsville, N. Y. Samples of drillings from this well have been arranged in a glass tube, and are in the possession of the Buffalo Society of Natural Sciences. The following record is compiled from an inspection of the drillings, and is based upon color and hardness as shown by fineness of comminution, and such other characteristics as could be seen through glass. The well was started in the Onondaga limestone, extending from the surface to fifteen feet.

From 15– 50 feet, Bluish shale and water-lime.

50– 60 " Brown water-lime.

60–105 " Soft gypseous shales.

105–155 " Soft rock, containing pieces of white gypsum.

155–190 " Harder rock, light and dark chocolate color alternating

190–200 " Grey shale.

200–210 " Soft, light grey gypsum (?).

210–250 " Darker, soft, gypseous shale.

250–265 " Harder, light chocolate-colored limestone.

265–380 " Bluish grey gypseous shale.

380–400 " Darker gypseous shale.

400–420 " Light-colored, soft, gypseous shale.

420–450 " Softer, darker shales.

450–475 " Limestone.

475-485 feet,	Softer calcareous rock, with gas at 485 feet.
485-495	“ Hard brown limestone (?).
495-505	“ Soft light brown shale.
505-540	“ Hard compact sandstone or limestone.
540-645	“ Soft limestone or calcareous shale, gas at 626 feet in grey, medium soft limestone or shale.
645-680	“ Hard limestone.
680-720	“ Soft, light grey gypsum (?).
720-740	“ Soft, dark blue shales.
740	“ White limestone (?) with gas.
745-760	“ Darker limestone (?).
760-785	“ Blue-grey limestone.
785-790	“ Light red sandstone (Medina ?).
790-805	“ Dark red sandstone (Medina ?).
805-810	“ Light red sandstone (Medina ?), very hard.
810-820	“ Dark red sandstone (Medina ?).
820-838	“ White, hard sandstone.
838-845	“ Grey shale (?).
845-850	“ Darker grey shale.
850-890	“ White sandstone, hard, with gas at 850. (In white Medina ?).
890-bottom	Soft red shale.

The limestone at 450-475 feet is probably Niagara.

Well at Kenmore. (Drilled by Mr. Mook; record from Miss Flora King.) This well is located on Kenmore avenue, east of Delaware. The drill found here :

Drift,	. . . . .	30 feet.
Mineral water,	. . . . . at	60 “
Blue rock,	. . . . . “	65 “
Gypsum,	. . . . . “	150 “
Shale,	. . . . . “	300 “
Sulphur gas,	. . . . . “	350 “
Salt water,	. . . . . “	400 “
Hard rock and shale,	. . . . . to	700 “
Medina brown sand,	. . . . . 700 “	725 “
Gas in red sand,	. . . . . at	786 “

feet deep, getting gas in the white Medina near the bottom, with a pressure of 105 lbs. in thirty minutes. Well No. 2 was drilled to the depth of 1,000 feet, but struck gas at about the same level as the first, 800 feet. The two wells are now coupled together and used to furnish heat for cooking throughout the buildings. At first the gas was used under the boilers, running four forty horse power and two forty-five horse power boilers; but later coal was substituted for this purpose and gas reserved for the ranges. The original rock-pressure was 325 lbs., and the wells are said to furnish nearly as much gas as they did at the beginning. Information regarding the above wells was furnished by Professor Franklin W. Barrows and Mr. Winspear, engineer at the almshouse.

Kensington Well. This well was sunk near the railroad tracks at the north end of the Spaulding Machine Shops. No gas was found and no record kept of the rocks through which the drill passed.

A well was sunk for water at the Grattan & Jennings quarry, Amherst street and Delaware, Lackawanna railroad, without finding gypsum. The well was one hundred feet deep.

Wells of the Buffalo Cement Company. Near the Main street crossing of the New York Central Belt-line is a group of twelve wells, eleven of which have been drilled by the Buffalo Cement Co. Of the first three wells Mr. Charles A. Ashburner has given an account,* which I quote:

“Well No. 1 was drilled in 1883, with a diamond drill. * * * This well shows gas in a very limited quantity at a depth of 451 feet, 9 inches, which slightly increased in volume down to 490 feet, 6 inches, when the drilling ceased. The gas rock, as shown by the cores, is a very compact sandstone with numerous pin-point openings.

“Well No. 2 was put down in 1884 to a depth of 1,305 feet, but proved unsatisfactory. No salt was found and but little salt water; and no perceptible increase of gas was obtained beyond that shown in Well No. 1. Mr. L. J. Bennett writes that from the best information based upon his drill-notes, the various rocks penetrated in Well No. 2, were as follows:

Lower Helderberg limestone,	. . . . .	50 feet.
Salina shales,	. . . . .	550 “
Niagara and Clinton limestone and shales,	. . . . .	185 “
Medina sandstone,	. . . . .	520 “
Total,		1,305 feet.”

* See “Petroleum and Natural Gas in New York State,” by C. A. Ashburner, p. 19.

In the above record the rock called "Lower Helderberg" is probably the water-lime of the upper Salina. This well was located only six feet from Well No. 1.

Dr. Julius Pohlman, of Buffalo, examined the samples from Well No. 2. His record, quoted from Mr. Ashburner's report, is as follows:

"Beginning at a spot where the rocks of the water-lime group, suitable for the manufacture of cement, had been removed, and which is seventy feet above the level of lake Erie, or 643 feet above tide-water, the drill encountered the following strata:

From	1—	25 feet,	Shale and cement rocks in thin streaks.
	25—	30	" Tolerably pure cement rock.
	30—	43	" Shale and cement rock in thin streaks.
	43—	47	" Pure white gypsum.
	47—	49	" Shale.
	49—	61	" White gypsum.
	61—	62	" Shale.
	62—	66	" White gypsum.
	66—	73	" Shale and gypsum, mottled.
	73—	131	" Drab-colored shale with several layers of white gypsum, measuring eighteen feet in all.
	131—	133	" Dark-colored limestone.
	133—	137	" Shale and limestone.
	137—	140	" Dark-colored compact shale.
	140—	720	" Gypsum and shale, mottled, and in streaks.
	720—	725	" Limestone.
	725—	760	" Soft red shale.
	760—	785	" White solid quartzose sandstone, very hard.
	785—	1305	" Soft red shale.

"At 1,305 feet the drill was stopped. Permanent water was struck at forty-three feet; gas of fair quality as well as quantity, at 452 feet; salt water, leaving on evaporation about twelve per cent. of salt, was found at 555 feet. A shaft, twenty feet square, was sunk on the premises later, for the purpose of determining the feasibility of mining the gypsum, but the rush of water through the gypsum layer at forty-three to forty-seven feet, was so strong that a pump with a capacity of 2,000 gallons per minute failed to make any impression upon it, and the attempt was abandoned."

Well No. 3, according to Mr. Ashburner, was 517 feet deep, striking gas at about 460 feet. After torpedoing the well the gage showed sixty

pounds pressure in fifteen minutes and 142 pounds maximum rock pressure. Six months later it gave 27,600 cubic feet in twenty-four hours, 865 feet from the well, by meter measurement.

The other wells range from 517 to 565 feet in depth, and show essentially the same geologic conditions as the preceding. All the wells were connected together and the gas piped to the cement works, where it was used as fuel under the boilers and to houses along Main street, supplying in the latter about thirty-five fires. Mr. Bennett informs me that the gas was measured for one season and a daily record kept of the amount consumed. The meter showed from 58,000 to 80,000 cubic feet per day, 65,000 cubic feet being, in his opinion, a fair average. The total amount which passed through the meter during the season was 18,321,600 cubic feet.

The core of Well No. 1 is now in the possession of the Buffalo Society of Natural Sciences.

The Jefferson and Best streets group. In the vicinity of Jefferson and Best streets is a group of thirteen wells which were at one time very productive, but are now partly filled with water and give very little gas. The first of these was drilled in 1889 by Gerhard Lang, on his property at the northeast corner of Jefferson and Best streets. This proving successful, he afterwards drilled three more, two of which were good. One of these wells supplied two boilers at his brewery for a year. After that the pressure gradually decreased and at present all four wells are abandoned.

In the same year, Mr. George Rochefort drilled two wells on the southeast corner of the same streets, opposite Lang's property. These were about 1,000 feet deep. Well No. 1 furnished fuel and lights for his brewery, running four boilers and a malt-kiln, and displacing about thirty tons of coal a day. The gas from Well No. 2 was piped to private houses. Mr. Rochefort informs me that the pressure in Well No. 1 was, at the start, 525 pounds, and in Well No. 2, 490 pounds.* At present the pressure is about seventy-five pounds. According to Professor F. W. Barrows, one of these wells was 800 feet deep, and the other 1,100 feet.

Mr. C. Schuler, near the southwest corner of Best and Jefferson streets, has a well which was drilled about the same time as the Rochefort wells. It is about 1,000 feet deep and at one time yielded a fair amount of gas. At present it is full of water and furnishes only gas enough for one house.

Four other wells were drilled on lots fronting on Jefferson, between Best and High streets, known respectively as the Steffan, Weppner, Everson and

* A record obtained by Professor Barrows in 1890, gives pressure at that time as 200 pounds and 150 pounds.

Ruhl wells. Two more were located in the rear of these on an alley running west from Berlin street. The relative location of these is shown by the accompanying map. The Everson well, in the rear of 971 Jefferson street, had, according to the owner, Mr. Edward L. Everson :

Drift,	40 feet.
Salt water,	at 700 “
Gas sand (white Medina with gas),	“ 940 “
Well was drilled to	“ 1,010 “

At the start the gage showed 300 pounds rock-pressure, which had fallen, at the time of my visit, to fifty pounds. The hole is now partly full of water which has to be removed at frequent intervals with a “Klein” pump. Professor F. W. Barrows says of this well: “It gave a pressure of 280 pounds in twenty-five minutes, and furnished enough gas to supply thirty or more families with fuel and lights. It was left wide open for months, allowing the gas to escape into the air.”

Well corner Sherman and North streets. (Drilled by Mr. Mook; record from Professor F. W. Barrows.)

Clay,	16 to 20 feet.
Limestone, Corniferous,	“ 122 “
Limestone, water-lime,	“ 150 “
Reddish brown water-lime,	at 150 “
Red sand and gas,	“ 860 “
Red sand and gas,	“ 875 “
Gas,	“ 935 “
Gas,	“ 960 “
Red shale,	from 960 to 1,200 “

The rock-pressure in this well was 375 pounds, the pressure running up to 150 pounds in twelve hours.

Well at Cook's Distillery, East Side of Spring street, between Broadway and Sycamore. (Drilled by Mr. Mook; record from Professor Barrows.)

Flint,	80 to 125 feet.
Slate and gypsum, in streaks,	200 “
Limestone,	from 300 or 400 to 800 “
Medina sandstone,	100 “ 900 “
White sandstone,	between 900 and 1,000 “
Red shale below.	

No comment accompanies the above notes which were evidently given approximately from memory. Mr. Mook thinks the well was sunk to the Trenton at about 3,029 feet.

Well of Julius Binz, Broadway Brewery, corner Broadway and Smith streets. (Record, approximate, from Professor Barrows.)

Flint and lime,	700 feet.
Red sand,	200 "
White sand,	100 " (?)
Soft red shale,	1,000 "
Hard grey rock,	800 "

Sulphur gas was found between 600 and 700 feet. White sand with some gas at about 950 feet, and gas in soft red shale at 1,944 feet. No more gas was found in the well which was drilled to 2,760 feet.

The rock-pressure, in 1890, was seventy to eighty pounds in six hours, but the gas obtained would run an eighty horse power boiler only an hour at a time without "rest." The well supplied twenty-two ordinary gas-burners and the surplus was used with coal in the furnaces. The gas in this well ceased flowing on the last day of the year 1893. At night the burners showed the usual pressure, but on the morning of January 1st the gas had stopped entirely and none has been produced since.

Wagner Gas Wells, Wagner Car Shops, Broadway near City line. Two wells were put down here, the first to 1,200 feet and the second to 3,150 feet. According to Professor Barrows, Well No. 1 showed:

Red sand, with sulphur gas	at 790 feet.
Struck gas	" 1,000 "

The rock-pressure was 375 pounds at first.

Well of German-American Brewing Co., corner High and Main streets. (From Mr. Storck, Superintendent.) This well was drilled, in 1891, to a depth of 1,004 feet to obtain fuel for the brewery. A very little gas was found at 800 feet, but not enough to be of use. Water at a temperature of about 50° F., was found in abundance between 350 and 400 feet from the top, and is used to cool the beer. The cold water takes the place of ice and in that way has paid the cost of drilling the well.

Urban Well, on Oak street, 170 feet north of Genesee. (Drilled by Mr. Mook. Record by Professor Barrows.) This well is 2,000 feet deep and had a very little gas at about 1,000 feet. It is now furnishing only enough for one street-lamp.

Well at Water Works. (From Superintendent Knapp.) At 900 feet enough gas was found to warm a house. Well was sunk to 2,020 feet without finding more. No record of rock passed through by the drill was kept.

Buffalo Gas Light Co., corner Jackson and West Genesee streets. This well is located in the rear of the gas works near Fourth street and the Wilkeson slip. It was bored in 1872 to see whether gas existed there, and if so, whether this could be utilized for illuminating purposes. A small quantity of gas was found which was used as fuel under the boilers.

Mr. Boore, the superintendent, informs me that he measured the gas for twenty-four hours, and the meter showed 14,000 cubic feet. After ten or twelve days the flow of gas diminished to a quantity sufficient to furnish only one or two ordinary gas jets and the well was abandoned. The well seems to have been of the type of "great pressure but little gas," as it is said to have blown out the casing and seed-bag. The supply was not increased by torpedoing. Some sulphur gas was found near the bottom of the well, and water charged with some saline matter which was extremely caustic, and irritating not only to the tongue but to the skin. Information from Mr. Boore and Mr. Krumholz. Record of this well is in existence but could not be found at the time of my visit.

Well in South Park. (Record from memory by Mr. G. C. Shaffer, who was present while well was being drilled in July, 1895.)

Soil,	42 feet.
Shale and limestone,	280 "
Flint (?)	120 "
Limestone (?)	550 "
Shale,	60 "
Red Medina,	80 "
Shale,	20 "
Gas-sand,	16 "
Red shale,	600 "
Red sand,	300 "
White shale,	600 "
Brown shale,	200 "
Red shale,	100 "
Into Trenton,	320 "

The measured distance to the top of the Trenton was 2,960 feet. The drill passed through a part of the Marcellus at the top, Mr. Shaffer estimating it at sixty feet. Owing to the presence of the Stafford limestone so near the Corniferous it was not easy to distinguish them apart.

Hamlin Wells, American Glucose Works, near Elk street market. Two wells were put down here to furnish fuel and lights for the Glucose Works. Well No. 1 was bored in 1888 or 1889, near the northeast corner of East Market and Perry Streets, James Woodring doing the drilling. The written record of the well and a set of samples of drillings have been lost. Professor F. W. Barrows had access to the latter in 1890, and has fortunately preserved the following memoranda.

42 feet, Drift.

At 42 " Chocolate-colored limestone.

60 " White and grey limestone.

150 " Limestone.

650 " Grey shale and gypsum (salt water).

675 " Sandy, with spots of iron.

726 " Like the preceding.

800 " Grey slaty lime.

850 " Harder grey limestone.

905 " Rusty red sand, chestnut color.

910 " Same, but lighter color.

915 " Same, but lighter color.

920 " Same, but lighter color.

925 " White sandstone, rusted so as to look red.

930 " Dark red or brown, fine grains.

940 " Light grey, rusty patches, traces of oil.

955 " Like the last, but more rusty. Gas.

962 " Same, but finer grains. More gas.

967 " Greenish grey; large grains light-grey and others dark-red, all of a shaly appearance.

1,038 " Dark brown shale.

The rust mentioned by Professor Barrows in several samples was probably caused by chips from the drill oxidizing in the air. This well, according to Professor Barrows, was 1,050 feet deep. Mr. C. Wesley, of the Glucose Co., thought the well was 1,170 feet deep, but had no written record. The supply of gas from this boring was very small although the rock-pressure

was strong. At the time of my visit in November, 1885, it gave about enough gas to supply one or two ordinary gas burners.

Well No. 2 was drilled in May, 1890, on the east side of Chicago street, 600 feet from Scott street. No gas was found here and the well was allowed to fill up.

Well at the Buffalo Chemical Works, Abbott road and Elk street, near Buffalo creek. (From Mr. S. V. Fowler, superintendent, and James Woodring, driller.) In 1880, a well was put down here to a depth of 250 feet where a copious supply of water was found sufficient to fill the pipe and flow above the surface of the ground. The water, however, was heavily charged with sulphuretted hydrogen which unfitted it for use.

Later, wells were sunk for water at the oil refinery, a quarter of a mile up the creek where the Atlas Works now are. The same vein of water was reached and used to cool the condensers. Large pumps were used to furnish the great quantities necessary, drawing upon the supply so that the water ceased to flow at the Chemical Works. The latter well was then deepened to 1,032 feet, striking the Medina white sand. Here a small flow of gas was obtained, sufficient for the laboratories where it has been used ever since. As the Chemical Works were then outside the limits supplied with city gas, the natural product was a great convenience and has paid cost in that way. The pressure in November, 1885, was forty pounds. This well is located very near the southern limit of the Corniferous limestone. Fifty feet of drive-pipe were used, resting directly upon the limestone.

Well at the Snow Steam Pump Works, near Bailey avenue and the Western New York and Pennsylvania railroad. (Record from Mr. M. McIntyre, driller.)

Drift,	52 feet.	
Limestone and flint,	140 "	192 feet.
Limestone and shales, changing in color,	425 "	617 "
Chocolate sand (limestone?),	105 "	722 "
Sulphur gas and a strong flow of salt water about the middle. Water cased off at 700 feet. Shales, dark in color, with small shells,		
	40 "	762 "
Red sand, varying in color from dark red to a very pale red,		
	120 "	882 "
Shales and limestones, varying in color,	40 "	922 "

White sand, with gas, similar to the

white Medina,	15 feet,	937 feet.
Shales, white and red, soft-drilling,	50 “	987 “
White Medina sand, with gas,	20 “	1,007 “
Red shale to bottom,	18 “	1,025 “

Above record from the original kept at the time of drilling.

A well was also sunk at the Atlas Works, about midway between the last well and the Buffalo Chemical Works. No record of this was obtainable; but Mr. McIntyre informs me that the rocks passed through by the drill were almost identical with those at the Snow Pump factory, so that one record would answer for both.

There is also a well on Grey near High street, of which no record was obtained. The geologic conditions are said to be nearly the same as in the Sherman-North well.

The Schüsler Brewing Co., corner Emslie and Clinton streets, have a well 1,100 feet deep. At first enough gas was obtained to light the brewery, but it has now ceased to flow. The gas horizon here was 200 feet from the surface. Very little gas was found in the Medina.

Other Wells Outside the City of Buffalo.

Well No. 2, at Depew. (J. W. Stearns, driller.)

Drift,	34 feet.
Corniferous, water-lime and Salina shales,	560 “
Niagara,	200 “
Shales,	60 “
Clinton,	30 “
Red Medina,	90 “
White Medina (no gas),	12 “
Red shale to 2,150 feet,	1,164 “
Oswego sand,	75 “
Shale to top of Trenton at 2,855 feet,	630 “
Through Trenton at 3,575 feet,	720 “
Dark grey sandstone to 3,685,	110 “

Some gas was found at about 1,700 feet, and a little salt water in the lowest sandstone. Well No. 1 was bored about 200 yards east of No. 2, and had essentially the same record down to, and through the white Medina. Both wells were started upon the Corniferous limestone, about one and one

half miles from the southern limit of the outcrop. Pressure in No. 2 is said to be 620 pounds per square inch. A company is now being formed to pipe the gas through the village of Depew.

Alden Wells. Five wells have been sunk here, four of which are started upon the upper part of the Marcellus shale near its junction with the Hamilton, and the other a little farther south upon the Hamilton shale. A pocket of gas was found in one well sufficiently strong to lift the tools from the well. Mr. J. W. Stearns thinks this was above the Corniferous limestone. The largest supply was found in the Medina. About 100 houses are supplied with fuel from these wells and at present there is no appreciable diminution in the pressure. The following data regarding one well were furnished by Mr. Best, who has charge of gas distribution at Alden :

Soil,	38 feet.
Slate (casing),	220 “
Top of Medina,	1,190 “
Medina,	90 “
Pocket,	20 “
Well drilled to 1,300 feet.	

The top of this well is about thirty feet below the level of the railroad station.

Lancaster Wells. A well was sunk a few years ago on the left bank of Cayuga creek, where it begins to widen to form lake Como. Mr. James Payne informs me that the drill stopped in red shale at 1,350 feet. No gas of any consequence was found. Another boring, said to be about 300 feet deep, was made on the Lawson road about a mile south of the Como well. A little gas was reported here, but I have not been able to verify the report. A well was also drilled on the Borden road about eighty rods south of the Buffalo and Lancaster electric railroad. Mr. James Woodring, who bored the well, informs me that the well was 1,200 feet deep. The white Medina was here but four feet thick and no gas was found. These wells are located a little above the Stafford limestone of the Marcellus.

*Well at Gardenville. July 1885.**

Marcellus shale,	60 feet.
Limestones (Corniferous and water-lime),	205 “
Salina shales to Niagara,	800 “

* See Report State Geologist, 1885.

A full record of this well was not obtained, the drill having penetrated only about fifty feet into the Niagara at the time of my visit. Some gas was found on the top of the Niagara, enough for one or two stoves, and brine in a few feet of shale a short distance above.

Father Baker's Well, West Seneca. This is located in the village of West Seneca, 175 yards east of the present terminus of the electric railway. Mr. Woodring, who drilled the well, informs me that it was completed in February, 1891. It was cased to 900 feet and was 1,133 feet deep when finished. A thirty-quart shot of nitro-glycerine was exploded in the gas sand, and the pressure immediately ran up to 400 pounds in thirteen minutes, with a maximum rock pressure of 600 pounds. The Rev. Mr. Baker informs me that the pressure is now 375 pounds, while he is using it. The gas supplies the church and school buildings, saving \$3,000 a year in fuel, and also furnishes fifty families with heat and light.

The Reed Well, located one hundred yards further east, is also a good well, the owner claiming 600 pounds rock pressure.

Well on Eli B. Northrup's Farm, Spring Brook. (Completed December 17, 1893.)*

Drive pipe,	. . . . .	30 feet.
Casing,	. . . . .	174 "
Flint,	. . . . .	at 390 "
Through hard rock,	. . . . .	" 530 "
Salt water,	. . . . .	" 1,050 "
Top of Niagara,	. . . . .	" 1,055 "
Slate,	. . . . .	" 1,205 "
Sulphur gas,	. . . . .	" 1,243 "
More gas,	. . . . .	" 1,265 "
Clinton,	. . . . .	" 1,280 "
Top of Medina,	. . . . .	" 1,308 "
Top of gas sand,	. . . . .	" 1,388 "
Through gas sand,	. . . . .	" 1,402 "
Bottom of well,	. . . . .	" 1,410 "

Well on Elbert More farm, Spring Brook. (E. H. Argue, driller.)

Soil,	. . . . .	to 17 feet.
Fresh water,	. . . . .	47 "
Casing,	. . . . .	110 "

* Records marked with an asterisk were furnished by the South Buffalo Natural Gas Co.

Shale to flint,	. . . . .	435 feet.
Through flint,	. . . . . at	600 "
Niagara limestone,	. . . . . "	935 "
Sulphur gas,	. . . . . "	1,100 "
Sulphur water,	. . . . . "	1,165 "
Shale (sixty feet),	. . . . . "	1,245 "
Clinton,	. . . . . "	1,325 "
Top of Medina (?),	. . . . . "	1,433 "
Gas sand,	. . . . . "	1,436 "
Gas sand,	. . . . . "	1,438 "
Bottom of gas sand (white),	. . . . . "	1,460 "
Red rock (800 feet),	. . . . . to	2,260 "
Black shale, 900 feet, to Trenton,	. . . . .	3,100 "

Well in Eighteen-Mile creek, near Idlewood. (Record by Michael McIntyre, driller.) Well started on the Hamilton shales, near the Encrinal limestone.

Fresh water,	. . . . . at	70 feet.
Cased out,	. . . . . "	100 "
Corniferous limestone,	. . . . . "	270 "
Bottom of Corniferous,	. . . . . "	520 "
Shale and limestone,	. . . . . to	945 "
Salt water and some gas,	. . . . . at	1,000 "
Cased off,	. . . . . "	1,025 "
Shale and limestone,	. . . . . to	1,150 "
Small showing of gas (in Clinton),	. . . . . "	1,205 "
Red Medina,	. . . . . 1,205 "	1,320 "
White Medina,	. . . . . 1,320 "	1,345 "

The showing of gas was so small that the well was not torpedoed. Mr. McIntyre is of the opinion that a shot of nitro-glycerine would have made this well a fair producer. At present it furnishes about enough gas for a grate.

Well on William J. Heiser farm, Woodlawn Beach, Hamburg township. (From Mr. Philip Lerue, contractor and driller, Titusville, Pa.)

Soil,	. . . . .	7 feet.
Marcellus shale,	. . . . .	125 "
Lime and flint, very hard,	. . . . .	140 "

Slate and shells to 825 feet, 653 feet.

Here got the "sulphur sand," 80 "

With quite a flow of gas and some salt water.

From 733 to 1,000 feet, soft rock, 267 "

Red Medina at 1,000 feet, 110 "

Struck gas sand at 1,153. Gas sand seventeen feet thick, with very little gas. Total depth of well, 1,296 feet. Stopped in red shale.

Well on John M. Fick farm, West Seneca township. (W. H. Curtis. driller. Completed, June 2, 1894. *)

Drive pipe, 26 feet.

Casing, 123 "

Flint, at 318 "

Through flint, " 509 "

Niagara, " 890 "

Sulphur gas, " 1,020 "

Water and gas, " 1,060 "

Through water and gas, to 1,132 "

Slate,

Clinton, at 1,200 "

Medina sand, " 1,223 "

Through Medina sand, " 1,308 "

Gas sand, " 1,326 "

Through gas sand, " 1,337 "

Pocket, to 1,413 "

Well on Carl Saitz farm, West Seneca township. (Completed August, 1894. Good well.)*

To flint, at 366 feet.

Through flint, " 528 "

Top of Niagara, " 915 "

Bottom of Niagara, " 1,172 "

Top of Clinton, " 1,242 "

Bottom of Clinton, " 1,264 "

Gas sand, " 1,360 "

Through gas sand, " 1,375 "

Drilled, to 1,425 "

Well on John J. Clarris farm, West Seneca township. (Drilled by H. W. Curtis; completed December 2, 1893.)*.

Drive pipe,	18 feet.
Casing,	94 "
Flint,	at 190 "
Through flint,	" 365 "
Niagara,	" 740 "
Sulphur gas,	" 841 "
A little water,	" 856 "
More water,	" 880 "
Through Niagara,	" 975 "
Clinton,	" 1,052 "
Medina,	" 1,075 "
Through Medina,	" 1,160 "
Gas sand,	" 1,171 "
Through gas sand,	" 1,185 "
Bottom of well,	" 1,189 "

Well on Anthony Solly farm, West Seneca township. (Drilled by H. W. Curtis; completed September 19, 1894. Well dry.)*

Drive pipe,	18 feet.
Casing,	92 "
Flint,	at 188 "
Through flint,	" 354 "
Niagara,	" 725 "
Sulphur gas,	" 855 "
Water,	" 910 "
Through water,	" 985 "
Clinton,	" 1,045 "
Medina,	" 1,085 "
Through Medina,	" 1,170 "
Gas sand,	" 1,179 "
Through gas sand,	" 1,193 "

Well on J. A. Timmerman farm, West Seneca township. (Stearns & Leopold, drillers; completed April, 1894. "Dry hole.")*

Drive pipe,	17 feet.
Casing,	103 "
Hard rock,	at 360 "

Niagara,	at	980	feet.
Water and gas,	"	1,100	"
Slate,	"	1,180	"
Clinton,	"	1,250	"
Medina sand,	"	1,275	"
Some gas,	"	1,287	"
Slate,	"	1,355	"
Gas sand,	"	1,368	"
Bottom of gas sand,	"	1,376	"
Bottom of well,	"	1,395	"

*Well on John Schmalz farm, West Seneca township. (Completed August 17, 1894; "Dry hole.")**

Drive pipe,	50	feet.
Casing,	112	"
Flint,	at	188
Through flint,	"	350
Niagara,	"	740
Water,	"	912
Through water,	"	990
Clinton,	"	1,073
Medina,	"	1,095
Gas sand,	"	1,155
Through gas sand,	"	1,180
Gas sand,	"	1,186
Through gas sand,	"	1,200

*Well on the John Sax farm, West Seneca township. (Drilled by Stearns & Leopold.)**

Drive pipe,	17	feet.
Casing,	103	"
Top of flint,	at	185
Through flint,	"	365
Top of Niagara,	"	800
Salt water and some gas,	"	910
Top of slate,	"	995
Top of Clinton,	"	1,063
Top of Medina,	"	1,090

Top of gas sand,	at 1,175 feet.
Bottom of gas sand,	" 1,186 "
Bottom of well,	" 1,194 "

*Nagle Well, West Seneca township. (Sunk January, 1895.)**

To top of flint,	240 feet.
" bottom of flint,	425 "
" top of Niagara,	800 "
" bottom of Niagara,	1,040 "
" top of Clinton,	1,120 "
" bottom of Clinton,	1,148 "
" top of Medina,	1,148 "
" bottom of Medina,	1,228 "
" top of gas sand,	1,237 "
" bottom of gas sand,	1,247 "
Total depth of well,	1,300 "

*Well on Herman Metzler farm, West Seneca township. (Completed about September 10, 1894. A good well.)**

To top of flint,	280 feet.
" bottom of flint,	462 "
" top of Niagara,	805 "
" bottom of Niagara,	1,085 "
" top of Clinton,	1,115 "
" top of red Medina,	1,185 "
" bottom of red Medina,	1,255 "
Shale to top of gas sand,	at 1,267 "
To bottom of gas sand,	1,279 "
Depth of well,	1,341 "

*Well on Anthony Groell farm, West Seneca township. (Drilled September to October, 1893, by Stearns & Leopold; completed October 23, 1893.)**

Drive pipe,	19 feet.
Casing,	104 "
Flint,	at 180 "
Through flint,	" 340 "
Top of Niagara,	" 795 "
Sulphur gas,	" 845 "
Through Niagara,	" 995 "

Slate to Clinton,	at 1,070 feet.
Medina,	" 1,105 "
Gas sand,	" 1,188 "
Through gas sand,	" 1,202 "
Bottom of well,	" 1,209 "

Well on George Reichert farm, West Seneca township. (H. W. Curtis, driller; completed January, 1894.)*

Drive pipe,	18 feet.
Casing,	110 "
Flint,	at 225 "
Through flint,	" 390 "
Niagara,	" 785 "
Sulphur gas,	" 930 "
Through sulphur gas,	" 1,060 "
Clinton,	" 1,172 "
Medina,	" 1,192 "
Through Medina,	" 1,207 "
Gas sand,	" 1,220 "
Through gas sand,	" 1,229 "
Bottom of well,	" 1,233 "

Well on Henry Eisenhart farm, West Seneca township. (Completed February, 1895. Production in twenty-four hours, 800,000 feet).*

Thickness of top sand,	80 feet.
Thickness of bottom sand,	12 "
Thickness of pocket,	33 "
Depth of well,	1,348 "

Roth Homestead Well No. 1. Reserve. (Thomas Argue, driller.)
Drilled to 1,221 feet June, 1894.

Well No. 6 on Shoop farm. (Drilled by H. W. Curtis.)*

Drive pipe,	46 feet.
Casing,	870 "
To bottom of Niagara,	970 "
Clinton,	to 1,045 "
Medina,	at 1,070 "
Gas sand,	" 1,156 "
Through gas sand,	" 1,166 "
Bottom of hole,	" 1,170 "

John Roth Homestead farm, Reserve, Well No. 1. (W. H. Curtis, driller.)*

Drive pipe,	56 feet,	Drift,	56 feet.
Casing,	140 “	Shale,	140 “
Niagara limestone, . . . at	750 “	Cornif. and Salina, . . .	554 “
Through Niagara limestone “	980 “	Niagara,	230 “
Shales to Clinton, . . . “	1,052 “	Shales,	72 “
Medina,	1,072 “	Clinton,	20 “
Through Medina,	1,160 “	Medina,	88 “
Gas sand, to	1,168 “	White Medina,	8 “
Bottom,	1,181 “	Red shale (?),	13 “
			<hr/> 1,181 feet.

Well No. 2 on W. S. Roth farm. (October 1894; Thomas Argue, driller.)*

Top of gas sand,	1,205 feet.
Bottom of gas sand,	1,216 “
Pocket,	71 “
Total depth,	1,287 feet.

Well No. 4 on the Will Roth farm, near Reserve. (H. W. Curtis, driller. Struck gas October 15, 1889.)*

Drive pipe,	58 feet.
Casing,	134 “
Flint, at	183 “
Flint, to	362 “
Niagara, at	755 “
Through Niagara, “	985 “
Slate, 70 feet to Clinton, to	1,055 “
Medina, at	1,079 “
A little gas, “	1,097 “
Through Medina, “	1,148 “
Gas sand, “	1,160 “
Through gas sand, “	1,173 “
Bottom of hole, “	1,173 “

Schudt Well, Reserve, West Seneca township. (Drilled in October, 1894, by R. W. Argue. 200,000 cubic feet per day.)*

Top of flint, at	232 feet.
Bottom of flint, “	390 “

Top of Clinton,	at 1,100 feet.
Top of Medina,	“ 1,130 “
Bottom of Medina,	“ 1,210 “
Shale to top of gas sand,	“ 1,225 “
Bottom of gas sand,	“ 1,233 “
Pocket,	60 “
Total depth,	1,293 “

*Schneider Well, on Lot 175, West Seneca township, near Ebenezer.**

To top of flint,	240 feet.
“ bottom of flint,	425 “
“ top of Niagara,	800 “
“ bottom of Niagara,	1,040 “
“ top of Clinton,	1,120 “
“ top of Medina,	1,148 “
“ bottom of Medina,	1,228 “
“ top of gas sand,	1,238 “
“ bottom of gas sand,	1,247 “
Total depth,	1,302 “

*Goodker Well No. 1. (Drilled November, 1894.)**

Top of gas sand,	at 1,357 feet.
Bottom of gas sand,	“ 1,370 “
Pocket,	44 “
Total depth,	1,414 “

*Schraub Well. (November, 1894.)**

Top of gas sand,	at 1,149 feet.
Bottom of gas sand,	“ 1,160 “
Pocket,	6 “
Total depth,	1,166 “

*William Shaefer Well No. 1, West Seneca township. (Drilled April, 1894.)**

To top of sand,	1,226 feet.
“ bottom of sand,	1,239 “
Pocket,	33 “
Depth of well,	1,269 “

Well No. 2, Robert Ewald farm, Ebenezer, West Seneca township.
(Completed May, 1894; 150,000 cubic feet in twenty-four hours.)*

To top of sand,	1,206 feet.
“ bottom of sand,	1,213 “
Pocket,	30 “
Depth of well,	1,243 “

Hart Well, Seneca plank road, East Hamburg township. (Record from Mr. G. C. Shaffer.)

Soil,	20 feet.
Shale,	465 “
Flint,	160 “
Limestone (?),	635 “
Slate,	60 “
Red Medina,	80 “
Gas sand,	16 “

Hart Well No. 5. (Completed July 1894.)*

To top of first sand,	1,384 feet.
To bottom of first sand,	1,400 “
Pocket,	14 “
Depth of well,	1,414 “

Hampton Well, one and one-half miles east of the Hart Well, towards Spring Brook, on the Plank road. (Record from Mr. G. C. Shaffer.)*

Soil and quicksand,	50 feet.
Shale,	485 “
Flint,	190 “
Limestone (?),	635 “
Shale,	60 “
Red Medina,	80 “
Gas sand,	30 “

McCarthy Well No. 4, East Hamburg township. (Completed June, 1894.)*

To top of sand,	1,320 feet.
To bottom of sand,	1,332 “
Pocket,	54 “
Depth of well,	1,380 “

Berg Well, East Hamburg township. (Completed December, 1894.
1,300,000 cubic feet per diem.)*

Top of red sand,	at 1,304 feet.
Bottom of red sand,	" 1,339 "
Shale 34 feet to top of white sand,	" 1,373 "
Bottom of white sand,	" 1,387 "
Pocket,	" 4 "
Total depth,	1,391 "

*Shorr Well, East Hamburg township, one-half mile west of Webster's
Corners.* (A "dry hole.")*

To top of gas sand,	1,453 feet.
To bottom of gas sand,	1,478 "
Depth of well,	1,478 "

*Well on Miles P. Briggs farm, Duell's Corners, East Hamburg town-
ship.* (Completed April 15, 1894; Thomas Argue, driller. "A rank
duster.")*

Top of flint,	at 650 feet.
Top of Medina,	" 1,538 "
Through Medina,	" 1,623 "
Top of gas sand,	" 1,623 "
Bottom of gas sand and well,	" 1,673 "

Well on F. Boldt farm, East Hamburg township. (Completed April,
1894; H. W. Curtis, driller.)*

Drive pipe,	13 feet.
Casing,	100 "
Flint,	at 349 "
Through flint,	" 520 "
Niagara,	" 925 "
Water,	" 1,050 "
Through water,	" 1,180 "
Slate to top of Clinton,	" 1,240 "
Red Medina sand,	" 1,262 "
Shale,	" 1,351 "
Gas sand,	" 1,360 "
Through gas sand,	" 1,374 "
Bottom of well,	" 1,376 "

Well on Kleis Farm, near Windom, Hamburg township. (Mr. Mook, driller; sunk in August, 1895. Well gives about 75,000 cubic feet per day.)*

Soil,	28 feet.
Shale,	300 "
Flint,	180 "
Limestones and shale to Niagara (?),	640 "
Niagara (?),	75 "
Clinton,	25 "
Red Medina,	80 "
Shale,	30 "
White sand,	15 "

W. P. Roth, Well No. 1, Lot 298, West Seneca township. (H. W. Curtis, driller; completed October 15, 1892. Gas found at 1,079 feet.)*

Casing,	135 feet.
Flint,	at 182 "
Through flint,	" 362 "
Niagara,	" 755 "
Through Niagara,	" 985 "
Shale 70 feet to Clinton,	" 1,055 "
Red Medina,	" 1,079 "
White Medina,	" 1,160 "
Through white Medina,	" 1,173 "
Bottom, at	" 1,173 "

*Diehl Well, Lot 323, West Seneca township.**

Red Medina,	at 1,167 feet.
Gas sand,	" 1,259 "
Through gas sand,	" 1,271 "
Pocket,	" 39 "

J. H. Bassett Well, Lot 31, East Hamburg township, near Windom. (Completed March 28, 1895.)*

Red Medina,	at 1,265 feet.
White Medina,	" 1,348 "
Through white Medina,	" 1,360 "

John Ertel Well, Lot 463, East Hamburg township. (Completed March 24, 1895.)*

Red Medina,	at 1,308 feet.
White Medina,	" 1,398 "

Through white Medina,	1,410 feet.
Bottom of well,	1,447 "
Pocket,	37 "

Titus Well, Windom. (Drilled August 28 to October 21, 1895.)*

Well,	1,314 feet.
Top sand,	16 "
Pocket,	3 "

Saville Well.

Depth of well,	1,502 feet.
Pocket,	16 "
Top sand,	21 "

Bedford Well. (Drilled October 17 to December 3, 1895. 260,000 cubic feet per day.)*

Well,	1,230 feet.
Pocket,	38 "
Top sand,	10 "

Beaver Well, Ebenezer. (1,208 feet deep; good well.)*

East Aurora village. A well was drilled here between May and October, 1893, to the depth of 1,800 feet. It is located near the railroad tracks about 200 yards south of Main street. A very little gas was found, and also brine which produced, upon evaporation, twenty per cent. of salt. The depth at which they were struck was not ascertained.

About two miles southwest of East Aurora, on Cazenovia creek, a well was sunk in the eighties, of which the following is a partial record: †

Shales (Lower Portage Hamilton and Marcellus),	695 feet.
Corniferous limestone (and water-lime?),	165 "
From the above limestones to salt,	605 "

Saturated brine was found at 1,465 feet, filling the well and running over the top. The stratum in which the brine occurs was reported to be seventy feet thick. No attempt was made to utilize the brine, and the well is now abandoned. At one time considerable gas is said to have escaped from this boring, but at the time of my visit, in August, 1895, the amount would barely support one ordinary gas jet. Surface gas in quantities sufficient to burn, bubbles up from crevices in the bed of the creek in several places near by, and I suppose that the gas found in the well was from the same source, the black shales of the Portage group.

† See Report State Geologist (N. Y.), 1885.

Half a mile further up the same creek a well was drilled for oil, about the year 1875. No record of this is preserved, but it is reported that gas was found at 900 feet, with sufficient pressure to throw water over the top of the derrick.

Well at Pipe Creek, near West Falls. This well was put down in 1865, to the depth of about 1,000 feet. Mr. A. L. Henshaw, who furnished me these facts, says that the pressure at first was sixty pounds. The well is now full of water from which the gas bubbles up vigorously, furnishing about a cubic foot a minute. Another shallower well was bored a little further up the creek, but struck no gas. Surface gas escapes from fissures in the bed of the creek in several places. One crack furnishes enough for four or five gas-burners.

The Colden Well. (Record by Mr. A. H. Hayes.) This well is located one-fourth mile south of the village, on the west side of the creek. It was put down by a stock company of which Mr. Hayes was an officer. Gas was found at 300 or 400 feet in sufficient quantity, as Mr. Hayes thinks, to supply the village with fuel. From the description of the flow, it appears that the well must have been a good one, but the gas was allowed to go to waste. Here, also, there is much surface gas. A water well fifty feet deep, in the village, furnishes enough gas to keep a street-lamp going all the time.

Another well, on the hill between Colden and Boston, was bored about the time the Colden well was sunk. Mr. A. L. Henshaw visited this while drilling was in progress and saw the gas burning. From his description I should judge the flow was not large.

Wells at Patchen, Boston township. Two wells are located here, one in the village near the creek a short distance south of the bridge, and the other some fifty rods further up the creek. Mr. John H. Wait, who worked upon the well while it was being drilled, furnishes me the following information:

Well No. 1 was sunk on the Wait farm, to the depth of 762 feet, by a company from Oil Creek, Pa., about the year 1860. A strong vein of gas was found at 272 feet, which escaped with such force as to stop drilling for three days. The pressure is described as sufficient to lift two men seated upon the ends of a plank laid across the top of the casing.

Later on another company, from Oil Creek, leased farms in this vicinity and put down well No. 2. At 320 feet they struck gas, but the flow was not so strong as in well No. 1. At 940 feet they struck a hard rock (the

Corniferous ?) which proved so difficult to drill that the well was abandoned at 1,000 feet. This well still gives a blaze two or three feet high when ignited. Near the old well is a spring which gives off gas all the time. Six other gas springs are also reported from the town of Boston.

The Old Boston Well. This is located on the Henry Jones farm on the east side of the creek three or four miles south of Boston Corners. Mr. H. N. Drake of Findlay, Ohio, has kindly furnished me the following information regarding it:

"In 1878 or 1879, Mr. Chubbuck and myself took the contract to sink the well to the depth of 2,000 feet. For the first 1,000 feet the rock was black shale containing some gas. At 1,225 feet we struck a very hard rock which we called flint and limestone [Corniferous?]. At about 1,800 feet we got rock-salt about sixty or eighty feet thick, some of which was clear as crystal and some dark in color. The rest of the rock was a sort of rotten sand. At 2,008 feet we struck a vein of mineral water that colored the tools and cable black as ink and had a very disagreeable odor. The depth of the hole was 2,140 feet. There was no sign of oil from top to bottom."

The record of this well is very interesting for the reason that the presence of rock-salt seems to have been discovered here at about the time it was found in Wyoming county, a fact not heretofore published. The horizon of the Corniferous limestone is distinctly defined, and quite probably the water charged with sulphuretted hydrogen was the vein often found in the Niagara elsewhere in Erie county.

Well at Eden Valley. (From Mr. Daniel Schweickhart.) This well is located about a mile east of the village and about thirty feet higher than the railroad station. The well was sunk by Mr. Schweickhart previous to 1884, to obtain water for his brewery. The record given from memory at the time was as follows: *

Shale,	125 feet.
Blue hard rock,	200 "
Black slate,	300 "
Flint, lime and sand,	400 "
Brine in soft rock,	50 "
	<hr/>
	1,075 "

This well has since been deepened and furnishes enough gas for his house and brewery.

* See Report State Geologist for 1885

Angola Well. (About 670 feet A. T.) This well is located upon the farm of Mr. Alvin Eddy, three-quarters of a mile south of Angola on the road to Brant Centre. No record of the well is preserved, but Mr. Eddy gives me the following facts from memory :

Struck rock,	at 12 feet.
Limestone (Corniferous?),	" 800 "
Through limestone (?), a hard rock here,	" 1,300 "
Well drilled	to 1,500 "

Some gas was found near the bottom of the well. At present the hole is full of water and gives very little gas.

Mr. J. R. Newton of Angola has a well 450 feet deep on his premises. It is said to furnish sufficient gas to heat his house.

Well at Fenton, near Brant. (Drilled in 1890 and 1891.) The original record of this well is lost. The following facts are furnished by Mr. Clarence M. Fenton, who had charge of the work of drilling the well.

Soil and quicksand,	80 feet.
Hard blue rock,	to 1,200 "
Vein of water,	at 1,300 "
Red sand with good flow of gas,	" 1,900 "
Drilled	to 1,952 "

The well was torpedoed with 100 quarts of nitro-glycerine and filled with packer and two-inch piping. When confined the gas pressure runs up to 1,000 pounds to the square inch. When blown off, the well furnishes only gas enough to fill a three-quarter inch pipe, or about 10,000 feet per day. This is used to run the cappers of the Erie County Preserving Co.'s cannery at Fenton, and supplies also two or three stoves. At present the well is three-fourths full of water heavily charged with salt.

While drilling was in progress a greasy rock was found at 1,200 feet, from which there was a flow of gas sufficient to make a flame two feet above the top of the well. At the same time the cable was smeared with a dirty mixture of tar and vaseline, smelling of petroleum.

Wells at Zoar.

Kelley Well, three-quarters of a mile west of Town line. (Completed January 10, 1888; record from Mr. Michael McIntyre, driller.)

Drive pipe,	60 feet.
Casing,	240 "
Top of Corniferous limestone,	1,500 "

First oil (green) and gas,	1,725 feet.
Second oil (amber), with salt water,	1,760 “
To bottom,	1,825 “

Kerr Well. (Begun August, 1888; record from M. McIntyre.)

Drive pipe (through drift),	379 feet.
Casing,	755 “
Top of Corniferous,	1,725 “
Gas,	1,885 “
Depth of well,	2,150 “

This is the largest producing gas well yet found in the county, and probably in the state. Gas was struck on October 27th. There was, at the time, in the well, the string of tools sixty-five feet long, together with more than 1,800 feet of rope, the whole weighing probably two tons. The escaping gas forced everything out of the well and at least 150 feet into the air. The drill, in descending, struck upon its end and penetrated the soil to the depth of fifteen or twenty feet, bending the stem like a wire. The noise made by the gas escaping through a five-inch hole could be distinctly heard at Springville, nearly six miles away. It was ten days before the pressure decreased enough to permit the resumption of drilling, and Mr. McIntyre estimates that during this time the daily flow could not have been less than twenty-five or thirty million cubic feet. The well is now owned by the Buffalo Natural Gas Fuel Co., and is known as the “Freak.” Ordinarily it is held in reserve, the pressure gradually rising to about 600 pounds. When an unusual amount of gas is needed, this gas is turned on to the line, and the well furnishes a million feet a day for a period of two or three weeks. By this time the pressure has fallen to about 300 pounds, and the well is shut off and allowed to “rest.” In the course of two or three weeks the pressure rises again to 600 pounds, and the well is re-opened.

The horizon in which this gas occurs is probably the upper part of the water-lime, the rock immediately below the Corniferous limestone.

Along the northern outcrop of this rock in Erie county, there is a layer, locally known as “bull-head,” which is filled with cavities from the size of a pea up to several inches in diameter. This rock also contains cavernous seams through which subterranean waters flow and appear at the outcrop in copious springs.

The immense volume of gas from the Kerr well indicates that the gas accumulates in a cavity so large that it cannot readily empty itself when opened.

Richardson Well, near Morton's Corners; Lot 92, Collins township.
(Begun March 5, 1889; M. McIntyre, driller.)

Drift,	. . . . .	80 feet.
Casing,	. . . . .	435 "
Top of Corniferous,	. . . . . at	1,925 "
Small show of gas,	. . . . .	" 2,195 "
Salt water,	. . . . .	" 2,675 "
Salt water, chocolate-colored sand,	. . . . .	" 2,785 "
Through limestone and shale,	. . . . .	" 2,815 "
Red Medina,	. . . . .	" 2,815 "
Through Medina,	. . . . .	" 2,935 "
Limestone and shale to white Medina,	. . . . .	" 2,955 "
Through white Medina,	. . . . .	" 2,990 "
Red shale,	. . . . .	" 2,990 "
To bottom,	. . . . .	3,303 "

Well on Monroe Kelley farm, Zoar, one-half mile west of Kerr Well.
(From Mr. Michael McIntyre.) This well showed the greatest thickness of drift known to me in the state, namely, 515 feet.

White Well, Zoar. (Completed July 2, 1892; record by M. McIntyre; controlled by the Standard.)

Drive pipe,	. . . . .	170 feet.
Casing,	. . . . .	460 "
Top of Corniferous,	. . . . .	1,535 "
First gas,	. . . . .	1,570 "
Second gas,	. . . . .	1,605 "
Depth of well,	. . . . .	1,795 "

White Well, No. 3, is 800 feet east of the Kelley Well. *White No. 1* is 600 feet east of No. 3. *White No. 2* is 1,400 feet east of Well No. 1. Of these No. 1 is the best well.

White Well, No. 1, Zoar flats. (Record by Mr. M. McIntyre.)

Drive pipe,	. . . . .	140 feet.
Top of Corniferous,	. . . . . at	1,530 "
First gas,	. . . . .	" 1,630 "
Second gas,	. . . . .	" 1,660 "
Depth of well,	. . . . .	1,795 "

Frye Well, Zoar. (Record by Mr. M. McIntyre; 100,000 cubic feet daily.)

Drive pipe,	165 feet.
Casing,	465 "
Corniferous,	at 1,570 "
First gas,	" 1,575 "
Second gas (best),	" 1,655 "
Third gas,	" 1,755 "
Depth,	2,001 "

White Well, No. 2, Zoar flats. (Record by Mr. M. McIntyre. Top of well 20 feet lower than Well No. 1, which is 1,400 feet away.)

Drift,	165 feet.
Casing,	385 "
Top of Corniferous,	at 1,560 "
A little gas,	" 1,565 "
Much salt water,	" 1,790 "
Abandoned,	" 1,800 "

Parkinson Well, top of hill, Zoar. (Record by Mr. M. McIntyre.)
This well furnishes about 25,000 cubic feet of gas daily.

Drive pipe,	325 feet.
Casing,	465 "
Top of Corniferous,	at 1,720 "
Show of gas,	" 1,730 "
Bottom of well,	2,021 "

The last well sunk at Zoar, September–October, 1895, is situated about 2,000 feet south of the Parkinson well. It had—

Drift,	60 feet.
Corniferous,	at 1,445 "
Drilled	to 1,802 "

Well on the south side of Cattaraugus creek, opposite Zoar. (Record from Mr. M. McIntyre; no gas worth piping.)

Drift,	80 feet.
Casing,	420 "
Top of Corniferous,	at 1,700 "
Show of oil and gas,	" 1,865 "
Depth of well,	1,950 "

A part of the gas from the Zoar field is piped into Springville, where it supplies about 120 families. The company controlling it is called the Springville Natural Gas Co., of which the officers are: Dr. Brooks, president ; H. Leland, treasurer; F. D. Smith, secretary. There is also a board of directors, of which Mr. M. McIntyre is a member.

The Springville Well. (From Mr. Mook, driller; well contains twenty-five feet of rock salt.)

Blue sandstone and shales,	1,800 feet.
Limestones,	750 "
Salt,	at 2,525 "
Well bored	to 2,550 "

At Gowanda, on the Cattaraugus county side of the creek, a well was sunk, in the eighties, by Mr. Silas Vinton, who gave to me the following record:

*Soil,	6 feet.
Shale,	450 "
Sand, with oil and gas,	4 "
Shale to "second sand," where more oil and gas were found,	450 "
Shale,	390 "
Hard rock (Corniferous and water-lime),	400 "
<hr/>	
1,700 feet.	

Mr. Charles S. Howland informs me that this well was deepened in February, 1889. The Corniferous limestone was reached at 1,390 feet. Drilling was continued to 2,251 feet, where salt water and mud were found and the well abandoned. The well, when cleaned of water, gives gas enough to fill a two-inch pipe with a light pressure. This well is located near the creek, about 200 yards east of the station.

Another well was drilled over thirty years ago on the Erie county side of the creek within the village limits. Locally it is known as the "Trunk Well." Gas was found at about 860 feet, and the well was drilled about forty feet deeper. This furnished gas for a house for several years, but is now "filled up with a substance resembling glass and nearly as hard."

* Vide Report State Geologist 1885.

Maps.

The location of gas wells and gas territory is shown upon the general map accompanying this report. Where the scale was too small to show details accurately, enlargements of the more important districts have been given. The map of the South Buffalo field was constructed mainly from data furnished by Messrs. E. M. Cobb, President, and C. T. Sloan, Vice-President of the South Buffalo Natural Gas Co., who have allowed me the free use of their maps and the original records of wells drilled under their direction. In this map, wells known to furnish little or no gas are marked (*). Those which were being drilled at the time the information was being collected are marked (†). Wells marked (‡) are either good producing wells now or were at some time. The names, location by lot number, and the character of the wells are shown on the following table designed to accompany the map.

Name of Well.	Lot.	Township.	
Samuel Wasson,	35	West Seneca.	*
Beck,	92	" "	*
C. Wansperg,	121	" "	‡
Solly,	172	" "	*
Sax,	174	" "	‡
W. Schneider,	175	" "	‡
Ebenezer Station,	189	" "	‡
Solly,	234	" "	*
Father Baker,	283	" "	‡
Reed,	284	" "	‡
J. Deppler, No. 3,	296	" "	‡
L. Roth, No. 2,	298	" "	‡
Susan C. Schudt,	332	" "	‡
W. Booth,	346	" "	*
Bedford,	359	" "	‡
P. Aubel,	337	" "	‡
Roth Bros.,	336	" "	‡
George Avery,	340	" "	*
G. Diehl,	323	" "	‡
Robt. Ewald,	329	" "	‡
Johanna Schudt,	330	" "	‡
G. E. Clarris,	364	" "	‡
A. Groell,	368	" "	‡

Name of Well.	Lot.	Township.	
C. Schudt,	373	West Seneca.	†
Herman Metzler,	372	" "	†
J. Nagel,	377	" "	†
George Reichert,	382	" "	†
H. Grotke,	386	" "	†
J. Timmerman,	395	" "	†
	432	" "	†
G. Reichert,	421	" "	†
William Schaefer,	453	" "	†
H. Eisenhart,	422	" "	†
J. Fick,	418	" "	†
William C. Grotke,	411	" "	†
	293	" "	*
	294	" "	†
	370	" "	†
	168	" "	†
Blossom,	102	Elma.	*
Elma Village,	58	"	†
Elma Station,	55	"	†
Springbrook (Albert Moore),	81	"	†
B. Root,	91	"	*
G. Schmalz,	86	"	*
	448	East Hamburg.	*
	400	" "	†
C. Spaver,	407	" "	†
J. Schwartz,	451	" "	†
Carl Berg,	454	" "	†
Timothy McCarthy,	455	" "	†
Duell's Corners (M. P. Briggs),	—	" "	*
F. Boldt,	458	" "	†
G. Seitz,	460	" "	†
	463	" "	†
Alfred Moore,	469	" "	†
Bassett,	31	" "	*
W. K. Saville,	14	" "	†
John Johnson,	17	" "	*
Henry J. Hart,	18	" "	†

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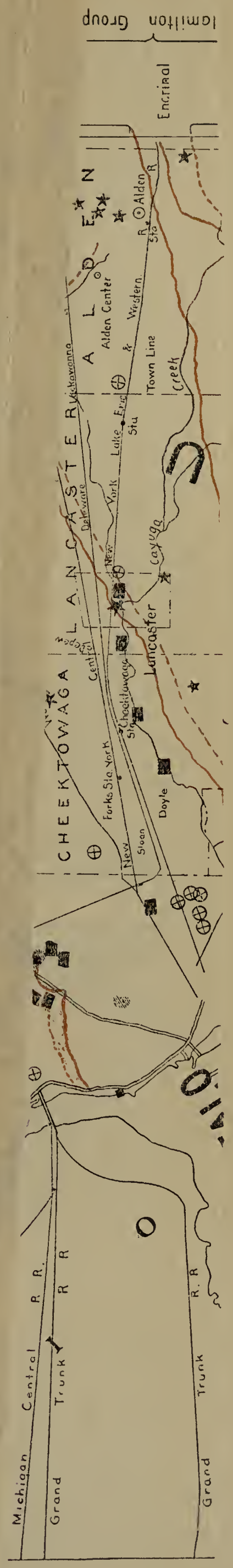
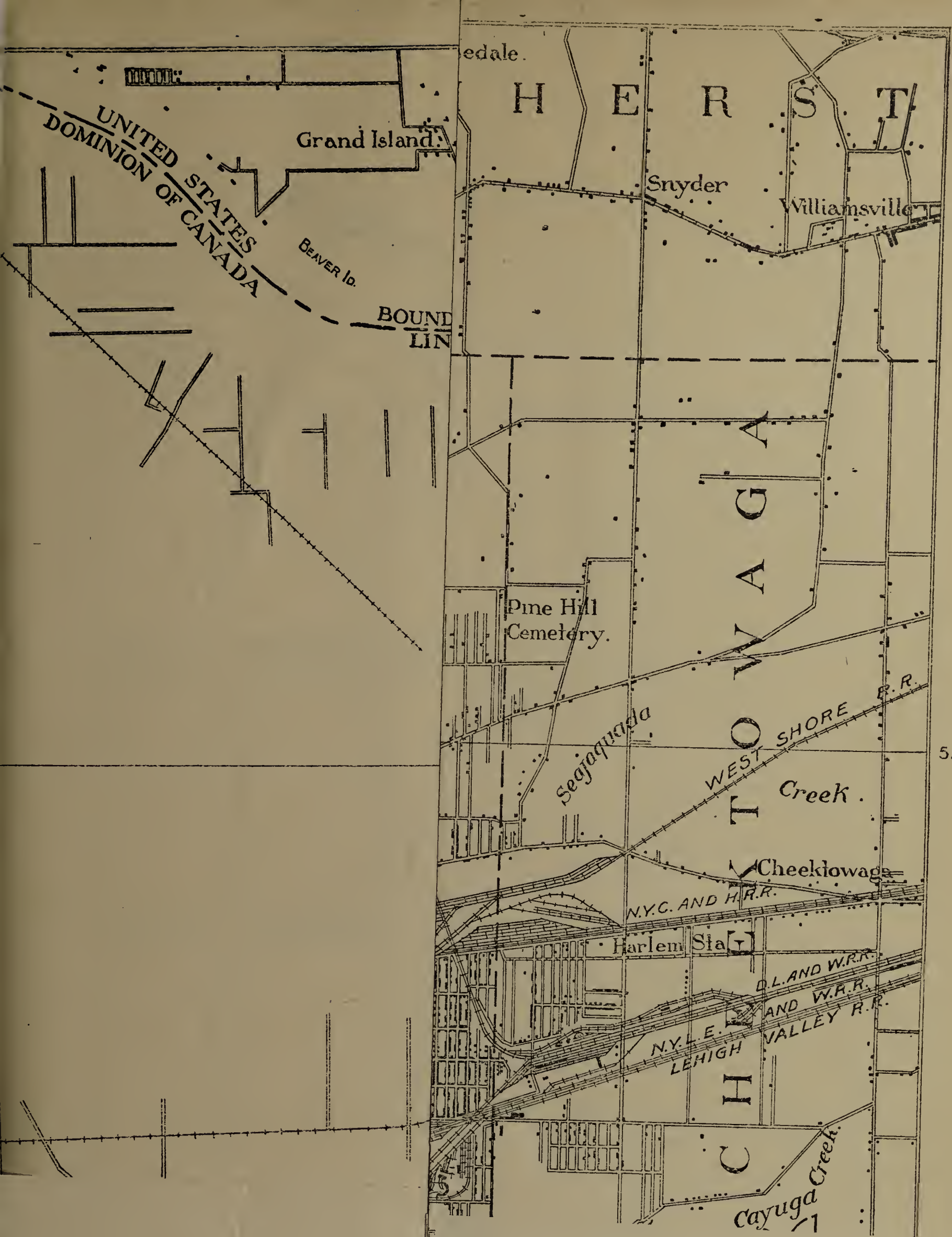


FIGURE 1





LINDEN

AMHERST

RUSSELL

SUMMIT

NT

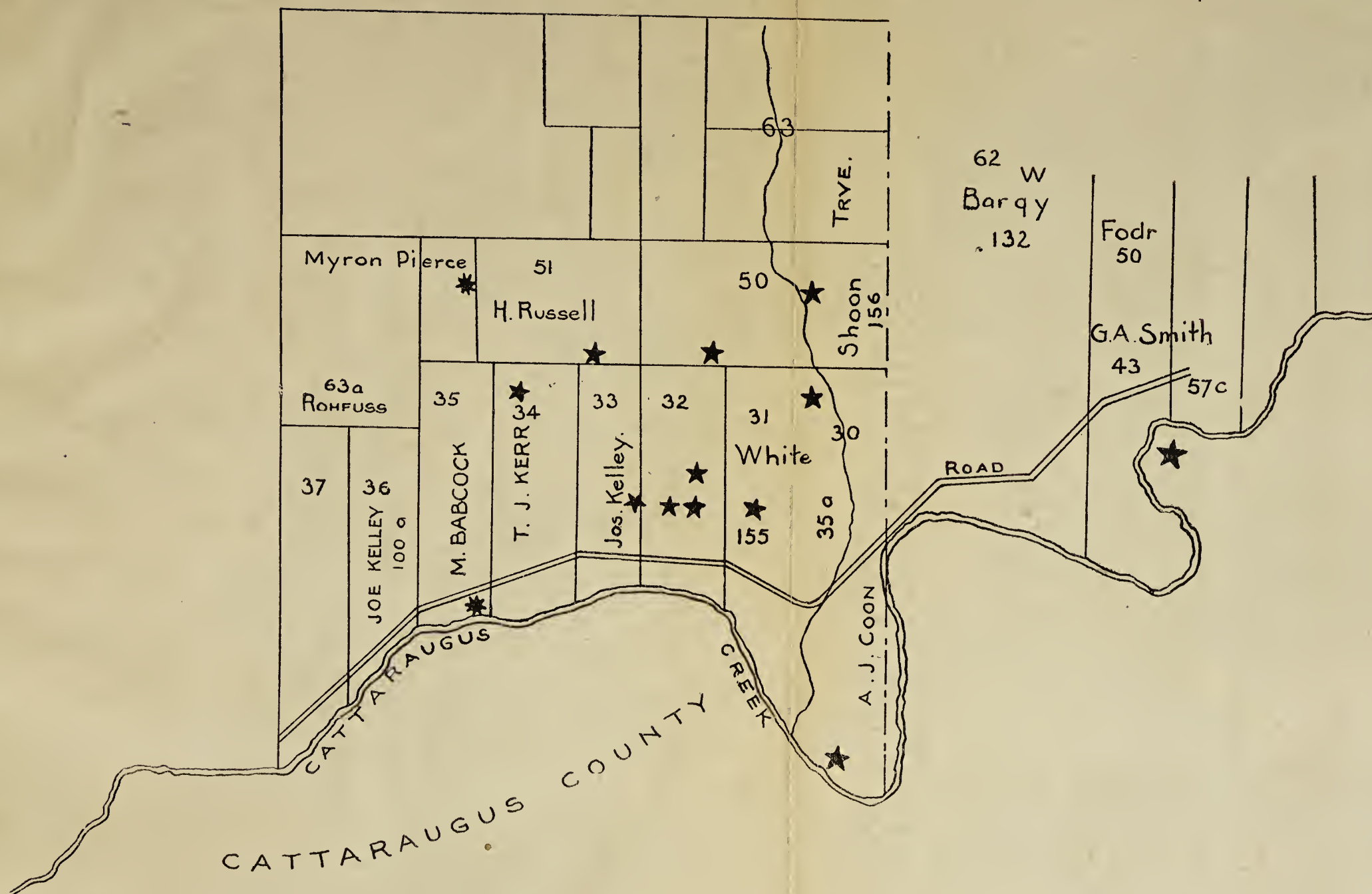


FIGURE 3



GROUP OF GAS WELLS NEAR THE MAIN STREET CROSSING OF THE NEW YORK CENTRAL BELT LINE, BUFFALO.
Productive wells are represented by stars; unproductive wells by double stars.

FIGURE 4



MAP SHOWING LOCATION OF GAS WELLS NEAR THE WORKS OF THE BUFFALO CEMENT COMPANY, MAIN STREET AND BELT LINE, BUFFALO.
 Star = Wells which have produced or are now producing gas. Double star = Non-productive wells.

FIGURE 5



MAP SHOWING THE LOCATION OF GAS WELLS NEAR JEFFERSON STREET, BUFFALO.
Wells at one time productive are represented by stars; unproductive wells by dotted crosses



PLAN OF THE BUILDING, SHOWING THE LAYOUT OF THE ROOMS AND THE POSITION OF THE STARS AND DOTS.

FIGURE 6



Name of Well.	Lot.	Township.	
Matthias Schorr,	21	East Hamburg.	*
B. F. Hampton,	11	" "	*
Adam J. Benzig,	26	" "	*
Franklin F. Holmwood,	64	" "	†
Kleis,	35	Hamburg.	†
Titus,	32	"	†
Heiser,	11	"	†

Wells Outside of Erie County.

The following well records are interesting in connection with the preceding:

Well No. 1, Philip Zavitz farm, located on Lot 35, third concession from lake Erie, township of Bertie, near the town line of Humberston, Ontario, Can. (Record from Mr. E. Coste.)

Soil,	7 feet.
Corniferous, to 25 feet,	18 "
Onondaga shale, gypsum dolomites (Salina pd.), to 415 feet,	390 "
Guelph and Niagara, 415–655 "	240 "
Niagara shale, 655–705 "	50 "
Clinton limestone, 705–735 "	30 "
Medina sand and red shale, 735–846 "	111 "
Gas in white Medina, at 836 " . sand, 13 " thick.	

At Point Abino gas was found at 500 and 575 feet below the surface, or 193 feet below the bottom of the Niagara limestone.

Well No. 1, Corfu, Genesee county, N. Y.; north of the village. (From Mr. J. W. Stearns.)

Marcellus shale,	30 feet.
Corniferous,	180 "
Limestone and shale,	458 "
Niagara limestone,	250 "
Niagara shale,	70 "
Clinton,	30 "
*Medina,	110 "
Red shale to bottom of well,	20 "

* Notes say "white Medina."
25

Well No. 1 on the Bradshaw farm, near Coomer P. O., District 13, Lot 36, town of Newfane, Niagara county, N. Y. (Record from Mr. E. Coste.)

Well begun in red shales of the Medina group.

Trenton,	at 1,435 feet.	
Continued	to 2,115 "	680 feet.
Calciferous sandrock, to 2,125 "		10 "
Laurentian,	at 2,125 "	
Drilled into Laurentian,		9 "
Depth of well,	2,134 feet.	

Well No 2 (drilled January 4, 1892; started on the red Medina. Record from Mr. E. Coste.)

Drive pipe,		24 feet.
Red Medina, dark Hudson river and Utica shales,	to 1,200 feet.	
Trenton,	1,200-1,910 "	710 "
Calciferous,	1,910-1,930 "	20 "
Hydromica and dark green schists of the Archean, from	1,930-1,980 feet.	50 "

No Potsdam sandstone was recognized. This well had a little gas, from 1,912 to 1,918 feet. Cased to 243 feet, and was dry after that.

Record of Well at Fulton, N. Y. (Mr. J. W. Stearns, driller.)

Drift,		43 feet.
Red sand,	to 690 "	
(A little gas at 320 and 370 feet.)		
Oswego grey limestone,	from 690 to 1,070 "	
Sand and limestone,	" 1,200 "	
Limestone and shale,	" 1,460 "	
Black shale,	" 1,640 "	
Top of Trenton,	" 1,640 "	
Gas,	1,680 "	1,685 "
Gas,	at 1,865 "	
Gas,	" 1,875 "	
Gas,	" 1,900 "	
Drilled	to 1,935 "	

A well in the village of Canandaigua, N. Y., has fifty-one feet of rock salt, according to Mr. James Woodring, of Buffalo, who sunk the well.

A well was also put down on the Indian Reservation at Versailles, N. Y., to the depth of 216 feet. No gas was found, but good water was obtained.

Surface Gas.

Small quantities of gas escape from crevices in the rocks in many places within the county. The most abundant supply comes from the Portage rocks in the horizon of the lowest sandstones along a line connecting roughly Wales Centre, East Aurora, North Boston and North Collins, and extending eight or ten miles southeasterly. The lower Portage shales also furnish supplies from rock crevices and water wells, and the Hamilton and Marcellus some from similar sources.

A few of the points at which gas has been noticed are at Eighteen-Mile creek, near the lake; between Wales Centre and East Aurora, where the town-line road crosses a brook; near Holland; in Cazenovia creek, between East Aurora and Griffin's Mills; on Pipe creek, near West Falls; in many places in the town of Boston; in the ravine between Shirley and North Collins and near Lawton's station.

Gas Horizons.

In the wells which have penetrated the Trenton limestone in Erie county, no gas has been found. The Bradshaw well, No. 2, in Niagara county, however, furnished a little in that rock. The Depew well, No. 2, struck a paying streak of gas in the red shale, a little less than 1,700 feet below the top of the Corniferous limestone. Nearly all the gas obtained within the limits of Erie county comes from the "white Medina" sandstone, although some is found in the higher "red Medina," and occasionally in the Clinton. The gas obtained from these sources is comparatively free from sulphur and makes excellent fuel and a fair illuminant.

The upper part of the Niagara group furnishes a variable amount of gas in many of the wells throughout the field. The most characteristic constituent of this gas is sulphuretted hydrogen (H_2S), commonly known as "sulphur gas." Water in contact with the gas dissolves out the H_2S , becoming "sulphur water." Hence sulphur gas and sulphur water may occur either together or separately, and the presence of either in the same formation may determine the gas horizon. In ten wells it was found at depths varying from 25 to 172 feet below the top of the Niagara, two having it at about fifty feet and three at 130 feet. In six wells the average distance was 130 feet, which may be assumed as the horizon where we would be most likely to find it.

Wells No. 1, No. 2 and No. 3, at the Buffalo Cement Works, struck gas at 450 to 460 feet, or about 400 to 410 feet below the Water-line. Allowing

386 feet for the Salina shales, this gas horizon would be fourteen to twenty-four feet below the top of the Niagara. Getzville well No. 17 struck some gas at 265 feet, which was unquestionably in the Salina shales; but the greater part was found at 474–481 feet. The record indicates Niagara at 361 feet or 292 feet from the surface of bed rock. The gas horizon was 113 feet lower and was undoubtedly in the Niagara.

In connection with this it is interesting to examine the record of the Boston well. Rock-salt was found here 575 feet below the top of the Corniferous or a probable distance of 407 feet below the water-lime. At 783 feet below the top of the Corniferous, or 615 feet below the water-lime, a vein of water was found, evidently sulphur water, which was very offensive and colored the drill and cables black. As the Salina shales are thickest in the trough containing the deposit of rock-salt, it is apparent that the drill in this well had penetrated some distance into the Niagara limestone. The Corniferous limestone and water-lime appear to act as the reservoir for gas in the Zoar field. In three wells quite a show of gas was found within ten feet below the top of the Corniferous, one had gas at forty-five feet, and two others at seventy and eighty-five feet respectively. Three had gas between 100 and 130 feet, and the famous Kerr well found it at 160 feet below the top of the Corniferous. Although a cavity was undoubtedly the reservoir in the last instance, the porous "bull-head" of the water-lime is the most probable receptacle for gas within the formations named.

A pocket of gas with a flow sufficiently strong to throw the tools out of the well was found in one of the wells at Alden. The reservoir was in the Marcellus and was quickly exhausted. Shallow wells in the Portage rocks furnish small quantities of gas in a few instances which are elsewhere noted.

Natural Gas Reservoirs.

The geologic conditions controlling the accumulation of natural gas are not sufficiently understood to furnish reliable data by which a gas well may be located. There are no surface indications of anticlines or other results of deep-seated disturbances which might act to accumulate and hold large quantities of gas. In the Medina sandstone, which is here the principal reservoir, the gas is found where the rock is soft and porous, but is not found where the rock is hard. Whether this difference in hardness is due to flexure of strata or to some inherent quality of the rock itself, is still to be determined. Good wells are found close by poor ones, and several "dry" wells

may almost encircle a good one. The most experienced and intelligent men in the gas business frankly say that the drill is the only means of ascertaining whether gas exists in the earth or not. And after a careful study of the conditions existing in Western New York, I am free to express the opinion that the presence of gas in any locality in Erie county can not be predicted as securely as, for instance, a salt-well might be located in Wyoming or Livingston counties. In localities already tested, the chances may be two out of three that a new well will find a paying quantity of gas. In a new district the first well might get it, or it might not be found by sinking five or six. The wells put down during the past year, however, go to show that natural gas is much more widely distributed than was at first supposed, and that it is destined to wider use, both for fuel and lights. The greater part of the best wells are located along the Marcellus outcrop or on the Hamilton shales, just south of it; but it is extremely doubtful whether proximity to the outcrop has anything to do with the production of the gas.

It has been shown that surface gas exists in considerable quantities in the Portage shales. Although the supply from this source may not be sufficient to pipe to a distance, it appears to me that this might be utilized for local consumption. A well from 100 to 500 feet deep, if properly located, might furnish fuel for several houses; and it is by no means impossible that the time will come when a gas well in that region will be considered as necessary as a water well.

A General Geologic Section of Western New York, from Lake Ontario to Cattaraugus Creek.

By using the well-records from Niagara county, in connection with those from Erie county, the approximate thickness of the several formations is shown from the Archean, up to near the top of the Portage group. Since the measurements have been obtained from drillers' records, lithologic characteristics, such as hardness, color and material have in most cases furnished the data by which the formations are distinguished.

The Portage Group, in the Boston well was 938 feet thick; in the Zoar wells 1,346, 1,395, 1,490; and in the Richardson well, 1,541 feet.

The Genesee shale, at Eighteen-Mile creek, was seventeen feet thick, but is thicker eastward. At Windom it is estimated, without actual measurement, to be 25 feet.

The Hamilton and Marcellus shales in the well at Eighteen-Mile creek are, together, 287 feet thick. In the Heiser well at Woodlawn, one and one-half miles north of the edge of the Hamilton, the Marcellus is 125 feet thick, and is probably not less than 140 feet in all, making the Hamilton shales, 147 feet.
and the Marcellus shales, 140 feet.

The Corniferous limestone, Onondaga limestone and Water-lime, all being hard, are classed together by drillers as "flint." The well at the Snow Steam Pump Works, near the southern edge of the Corniferous, in Buffalo, had 140 feet of this flint. The Sherman-North street well had 150 feet. An examination of twelve other wells gives an average of 168 feet. The wells at the Bennett cement quarries, Buffalo, begun below the Onondaga, had, with the cement and "bull-head" lying above the mouth of the well, sixty-two feet of water-lime. The Fogelsonger well on the same horizon had sixty-two feet of hard water-lime, thus giving of
Corniferous and Onondaga limestone, 108 feet.
Water-lime, 60 feet.

The Salina shales, from the bottom of the flint to the hard rock known to drillers as Niagara limestone (but possibly including some Salina), averaged in ten wells, 386 feet.
Making the Salina and Water-lime together 446 feet thick.

The Niagara includes an upper limestone and a shale below, the latter averaging seventy-two feet in thickness. The whole in ten wells averaged 319 feet.

The Clinton was from twenty-three to forty feet thick, and averaged in nine wells, 27 feet.

The Medina, including (a) a hard red sandstone, the "red Medina;" (b) a shale of varying thickness, sometimes absent entirely, and (c) an almost white siliceous sandstone, known as "white Medina." These collectively ran from 83 to 140 feet in thickness, the white band being from four to thirty feet, but usually ten to fifteen feet thick.
Nineteen wells gave, of the whole, an average of 109 feet.

From bottom of white Medina to the top of the Trenton limestone, the Albert Moore well gave 1,635 feet; the South Park well, 1,800 feet, and the Depew well, 1,869 feet.

The Trenton limestone in the Bradshaw well, near lake Ontario, was 680 feet; in Well No. 2, 710 feet, and in the Depew well, 720 feet.

The Calciferous, resting on the Laurentian gneiss, was in the Bradshaw well, No. 1, ten feet; in No. 2, twenty feet; in the Depew well, 110 feet.

Without reaching the Archean, total thickness of above section, 5,561 feet.

The deep Richardson well at Zoar, which has been quoted above, passed through the white Medina at 2,910 feet.
Adding from the Depew well, the shales below, 1,869 “
And the Trenton, 720 “
With Calciferous, 110 “

We have a total of 5,609 feet.

A difference of only forty-eight feet in the results, as shown by the two computations, shows that the estimates are approximately correct. It will be noted, however, that the Calciferous was not fully penetrated in the Depew well, and that the Richardson well is not situated upon the highest land in that part of the county; so that the total thickness is probably from 100 to 200 feet more than the result given above.

Rock-Salt.

The borings in Erie county have added materially to our knowledge of the extent of the Western New York salt-field. Thick beds of rock-salt are known to occur at Boston Corners and at Springville, while the northern edge of the same deposit was pierced in the old well southwest of East Aurora. At Gowanda and Zoar the drill passed through the Salina shales, finding brine, but no salt, in the rock-salt horizon. The limit, north and west of which rock-salt has not been found in the county, and is not likely to be found, is a line drawn from East Aurora to Patchen, curving westward near Boston Corners and thence southward, crossing Cattaraugus creek about three miles west of Springville. It is, therefore, probable that a well sunk to

